THE TEACHING OF AGRICULTURE IN THE HIGH SCHOOL

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WITH AN INTRODUCTION

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THE TEACHING OF AGRICULTURE IN HIGH SCHOOLS

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TO

DR. CHARLES D. WATKINS

WHOSE FINANCIAL ENCOURAGEMENT

HAS BEEN INVALUABLE

TO THE AUTHOR

IN HIS EFFORTS TO SECURE **A**

UNIVERSITY TRAINING

yet been able to define what shall constitute a unit in this subject.

There must be a philosophy of secondary agricultural education. Conscious aims must be set up and their desirability established, and means and methods worked out that shall be effective in securing the realization of these aims. Clearer ideas are needed of the pedagogical principles involved, and the aims in view need to be more clearly defined. In this day of special methods for the teaching of the various school subjects, there should also be one for the teaching of agriculture. So far as our knowledge goes, there is not a book that treats of the methods of teaching this subject in the high school. A considerable amount has been written on the methods of teaching nature study in the elementary school, and the agricultural colleges have their own peculiar methods adaptable to the needs of the college student, but the field embracing school methods in secondary agriculture is still a virgin one.

The methods of teaching the subject that seem to be invading the high schools come from three distinct sources. The teachers who have taught nature study in the grades, and who are now entering the high school to teach

agriculture, are bringing with them and applying the methods which they formerly used with mere children. The agricultural college graduate brings with him an excellent knowledge of the subject, but his knowledge of methods of teaching it is meager, and what he has learned from his college experience in this regard is poorly adapted to the instruction of high school pupils. The high school science teacher too often views this subject unsympathetically, and when he undertakes its instruction insists upon applying methods which he is in the habit of using with pure science, whereas agriculture must be taught as both a science and an art.

So long as secondary agriculture remains unsatisfactorily defined, there will be no harmony of agreement with respect to what shall be taught; so long as no definite principles of procedure are enunciated and established, the subject will remain unsystematized; and until we fully recognize agriculture as both a science and an art, we shall go amiss in developing proper methods for its instruction. It is in these three respects that the problems discussed in this book chiefly lie.

The thanks of the author are due to Dr. W. C. Bagley, Director of the School of

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G. A. B.

Columbus, Ohio,
December 1, 1910.

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INTRODUCTION

Of the need and value of agricultural courses in the American high school, there can be no reasonable doubt. The point of view in public education must always be social, and it would be futile to deny the social necessity for disseminating in as wide a circle as possible the knowledge that science has accumulated regarding the basic industry of human life.

But while the value of agricultural instruction is not to be denied, there are certain dangers that are involved in instituting any sweeping change in educational methods or in the content of an educational curriculum. Some of the dangers that beset the pathway of vocational education have been pointed out by educators who are able to keep a clear thought-perspective in the midst of the present-day clamor for an educational reform that will bring the schools nearer to the life of the people. This demand has been insistent and no one will deny its justification; but a widely spread and insistent popular demand inevitably encourages loose thinking

and hasty action. There has, perhaps, been no single epoch in the history of education when the need for a calm and dispassionate consideration of fundamental questions has been greater than in the present crisis. There has, perhaps, been no epoch when both teachers and laymen were so willing to grant offhand the arguments that the protagonists of current reforms have advanced. There is much cause for gratification in this condition; but there is also the greater reason for mature and sober reflection, for a careful and painstaking analysis of the problems, and for a serious study of factors and conditions in the light of the principles that have been induced from past experience.

There are several questions regarding the teaching of agriculture in the elementary and secondary schools that demand serious consideration. One of these questions concerns itself with the desirability of establishing separate schools for such instruction. This question is of vital importance, not only in connection with agriculture, but also in connection with every other type of vocational or industrial education. It is not a question to be answered dogmatically, much less to be brushed aside as purely academic in its ref-

erence. There is a possibility that specialized schools may emphasize class distinctions by precluding the constant intermingling of all children in the same classes, with the same teachers, and under the same democratic conditions of equality of opportunity. It may be that this danger is merely a figment of the imagination, but when the most precious legacy of the nation's past may be at stake, a supposed danger must be clearly demonstrated to be imaginary before it is left unheeded.

A second question that agricultural education presents has to do with the possible outcome of any form of education that makes a strong appeal to economic motives. The danger lies in the possibility of placing the powerful sanction of organized education upon self-seeking ideals. If agricultural education simply encourages the youth to regard scientific and economical methods of husbandry as a means of increasing his own material prosperity, it will fall far short of its possibilities; nay, more than this, it will simply feed the passion for individual gain that nature has already made sufficiently strong. It would be futile not to enlist the powerful economic interest in the service of agricultural

or any other type of vocational education. It would be fatal to leave this economic interest upon the primitive plane in which it first appears (and all too often persists). Inadequate methods of agriculture are fundamentally wasteful; but the task of agricultural education should be to teach the pupil that waste is not only a menace to prosperity, but a crime against the posterity; not only a force that may drive him ultimately to the wall or to the poorhouse, but a blow aimed at his children's children. In other words, the primitive economic interest is purely individual in its reference; the desirable economic ideal, which must be a gradual outgrowth of this more primitive interest, should be social in its reference. That economic science may be so taught as to leave with its students this ideal, has been effectively demonstrated by the agricultural colleges. There is no reason to doubt that a similar triumph may be achieved by the secondary schools. But in this day of unprecedented material prosperity, when ideals of self-indulgence are enjoying a social sanction that makes personal sacrifice harder than it has ever been before, it behooves education to be on the watch lest, through some over-

sight, it prove unfaithful to its trusteeship of the most priceless part of the race heritage. For when the social life of a people fails to reflect in a tangible form the ideals that are essential to its national vigor, there is no way to insure the perpetuation of those ideals save through their explicit recognition in the work of education. This simply means that agricultural education has to deal, not only with the facts and principles that modern science has applied to the art of husbandry, but also, and perhaps far more fundamentally, with those ideals of self-effacing service which the race wrought from its experience under sterner and harder conditions than exist to-day, and which the farm, *as a mode of social life* and not primarily as an economic industry, has hitherto cherished so faithfully, and imparted so effectively to its children. To lose these — to permit them to lapse for a single generation — would be fully as serious a catastrophe as to fail in the important task of disseminating scientific knowledge in as wide a circle as possible.

A third question that arises in connection with instruction in "applied" science owes its cogency to the possibility that, in the emphasis necessarily placed upon the eco-

nomic factor, the broader "cultural" values of the study of science may be lost to view. The ardent advocate of the "practical" education may easily ask: Of what use are culture and adornment if the power to earn a livelihood is lacking? What significance will the broader knowledge possess if the student is unable to apply it to the pressing economic problems of his daily life? This is a natural rejoinder and deserves serious consideration; but, after all, it does not strike at the fundamental difficulty. An equally admissible question just as naturally follows: Of what use is the best capacity to make a living without a corresponding power to make life worth while? The purely cultural and broadening effects of education have doubtless been overemphasized in the past. Secondary education especially has had an aristocratic origin and still retains, even in democratic America, its hall-mark of caste. But in democratizing secondary education, one should ask seriously whether there are no elements of this past that are worth preserving. After all, the ideal of culture does not seem totally inconsistent with the ideal of economic efficiency, nor is the proper sort of vocational education entirely without a

"cultural" influence. Again it all depends upon the spirit of the instruction, — upon the point of view. One may possibly find teachers of agriculture who are missing many golden opportunities to give their pupils a glimpse of the eternal problems and fundamental principles that lie just beyond the immediate details of the day's work. · But one may also find teachers of the "humanities" who never get their pupils beyond the mere letter and form and into the vital spirit of the subject that they teach. If the essence of true culture is to see the fundamental and eternal shining out through the seemingly trivial and transitory, there is no subject better adapted to provide culture than the subject of agriculture. The ardent curiosity of youth is nowhere more keenly alert than in the realm of nature, and when to this native interest in the objective world about him we add the powerful economic interest, we have conditions most favorable for driving home some truths that might otherwise wait long to find a lodgment. There is an opportunity here which devoted and broad-visioned teachers were not slow to take during a time when agricultural education was not so popular as it is to-day. If the insight into

nature that the students in the earlier agricultural colleges attained was not culture, I do not know what to call it. And what these earlier colleges did, the high schools of to-day and to-morrow may do, for the instruction may quite properly be upon a similar plane, and the pupils will be prepared better or at least equally well.

In the following pages, Mr. Bricker has analyzed the problem of agricultural education in the secondary schools. He has formulated the aims and methods of agricultural education in the light of the principles and hypotheses that have been gleaned from experience in the field of general education. It is true that, even in this older and better-worked field, the laws are few as compared with the hypotheses. It is also possible that some of the laws may operate only in the field from which they have been derived. It is, indeed, highly probable that the vocational factor will necessitate at least a modification and partial revision of many of the principles which are thoroughly valid when applied to general education. These principles become, in effect, only hypotheses in this new vocational field. In testing them, new problems will emerge and demand independent solution.

Some of these necessary modifications of existing principles have already been anticipated by the author. As a teacher of secondary agriculture, and as a supervisor and teacher in the field of general education, it has been his privilege to compare the effect of vocational and general courses, and this book has been written in the light of that experience. What additional readjustments will be needed can be demonstrated only through the further test of actual practice.

The author has had in mind, I believe, not only the three critical problems of vocational education to which I have just referred, but also a number of other opportunities and dangers that confront the worker in this new field. That he has weighed these carefully, and has applied to their interpretation the principles of education that are generally accepted to-day, the following pages abundantly testify.

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THE TEACHING OF AGRICULTURE IN THE HIGH SCHOOL

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CHAPTER I

THE NATURE OF SECONDARY AGRICULTURE

THE present status of secondary agriculture[1] is so unsettled that the term will not admit of a precise and specific definition. The trend of development of secondary agriculture is such, however, that we may in a general way define its boundaries and lay down fundamental principles as to what it should be, both in content and extent. Our first duty will be to locate it in the general scheme of agricultural education.

1. ELEMENTARY AGRICULTURE

Like the more popular sciences such as botany, physics, physiology, and chemistry, agri-

[1] Jewell, James Ralph: "Agricultural Education Including Nature Study and School Gardens," p. 78. Bureau of Education, Bulletin No. 2, 1907. Chapter IV. begins with a brief comparative study of secondary agricultural education in other countries.

culture has its common, everyday, elementary facts with which every one in country and village should be more or less acquainted. Such facts are: the proper time for planting seeds and for harvesting crops; the appearance of the various seeds, fruits, and plants in their various stages of development; the different kinds of soils; the use of manure; the structure and use of the common tools used on the farm and in the garden; the phenomena of the souring of milk, and the ripening of cream; the churning of butter; and a thousand and one other things common to ordinary farm life. Most of these elemental facts depend upon the habit of observation of the individual for their acquirement. An acquaintance with these things requires no previous knowledge of deep-lying and fundamental principles. Most country children know them and love them. What child has not opened its heart to the sweet influence of the dandelion blossoms, to the rippling of the brooks, and to the delightful odor of the new-mown hay? The martial spirit of the younger boys of the farm finds (too often) expression in many a hard-fought battle with the bumblebee. The hard-frozen soil, the washing effects of the streams, the endless sprouting of troublesome weeds,

the one abandoned and unproductive spot on the farm that was allowed to him from which to make a fortune, — these are some of the difficulties that most country boys have met in the course of their preadolescent life.

The foregoing will suggest a field for the work in elementary agriculture, or agricultural nature study, in the elementary school.[1] The object at this stage should be to get a wide, intelligent, and sympathetic acquaintance with the more evident things of nature and man's relation to them. Correct ideas should be gained of environmental materials.[2] Such an experience and knowledge of the more common things regarding plants, animals, and soils and other conditions of food production should be gained in order to form a prac-

[1] "The Agricultural Phase of Nature-Study," Chapter VII. of Bailey's "The Nature-Study Idea." The Macmillan Company, New York, 1910. See especially pp. 95–97, 179–180, 186, 188, 202–203, 205.

[2] Bailey, L. H.: "The Nature-Study Idea," Chapter I., "What is Nature Study?" pp. 4, 90. Scott, Charles B.: "Nature Study and the Child," Chapter III., "What is Nature Study?" pp. 89–101. Heath, Boston, 1900. "Nature Study for Grades of School below the High School." "General Principles and Plans," pp. 142–151, N. E. A. Report of the Committee of Ten on Secondary School Studies, 1904.

tical working basis for future instruction in the more abstract scientific principles of agriculture. It matters little whether the child so taught further pursues agricultural studies in the high school or college; the basis which he forms in his early study of nature will be useful to him throughout life, and will bring many joyful reactions by encouraging further observation and contemplation of natural phenomena.

To this stage belongs the school garden. There is, perhaps, no other agency through which the village or city child may get so true and wholesome an experience with nature and the elementary principles of agriculture. It is absurd to think of taking a class of high school boys to a garden in order to show them the differences in the appearance of sprouting beans, tomatoes, radishes, onions, and other seedlings, and yet such simple exercises are sometimes found necessary. All such elementary work should be done in the elementary school.

The work of the elementary school should confine itself to an elementary study of the common things of the farm, field, and forest. The names, uses, striking characteristics, morphology, and habits of the common objects

in the physical and the biological worlds, and something of their relative importance to man should be observed, studied, and fixed in the life of the child before he enters the high school.[1] "Agriculture, even in the grades, is something more than ordinary nature study. It is nature study plus utility. It is nature study with an economic significance. It is nature study which articulates with the affairs of real men in real life. It is nature study in which the child may influence the process. It is nature study which distinctly stimulates industry."[2]

2. Collegiate Agriculture

We have endeavored to show the nature of the work to be done in elementary agri-

[1] Crosby, D. J.: "Training Courses for Teachers of Agriculture," pp. 215–216. Yearbook, Department of Agriculture, 1907. See also Circular No. 60, Office of Experiment Stations, Department of Agriculture, on "The Teaching of Agriculture in the Rural Common Schools," and the Report of the N. E. A. Committee on "Industrial Education in Schools for Rural Communities," 1905.

[2] Davenport, E.: "Education for Efficiency," p. 139. Heath, Boston, 1909. Chapter VIII. is a discussion of "Agriculture in the Elementary Schools."

culture. We shall now take a brief view of agricultural instruction in the college.

At present much of the agricultural instruction in the college is of a secondary character.[1] This has been made necessary because the secondary schools have hitherto neglected to give instruction in the subject of agriculture, and the colleges have been compelled to receive their students directly from the elementary or rural schools and prepare them for the real collegiate work. But since the secondary schools are beginning to take up the work of instruction in agriculture that they are best qualified to impart, the colleges are gradually raising their entrance requirements, and are discontinuing the strictly secondary work.[2]

The work of the agricultural college should lie in the investigation and study of the more deeply fundamental problems of agricultural science and practice. The work here is highly scientific. " Advanced botany, chemistry,

[1] True, A. C.: "Progress in Secondary Education in Agriculture," p. 494. Yearbook, Department of Agriculture, 1902.

[2] True, A. C., and Crosby, Dick J.: "The American System of Agricultural Education." Office of Experiment Stations, Circular 83, p. 12.

physics, zoölogy, and entomology are taught, and the science of agriculture is emphasized more than the art."[1] Just as the aim of the engineering college is to turn out professional engineers who are in effect specialists in their various lines, so the aim of the college of agriculture is to give to the world agricultural specialists. A prominent feature of the work in the institution which stands at the top of the agricultural system is research work for the discovery and application of new facts in the science and the art of agriculture.[2]

3. Secondary Agriculture

The work of the secondary school lies between these two extremes. "Before discussing details further, let me say that when I speak of teaching agriculture in our high schools, I mean *agriculture*. I do not mean nature study, nor do I mean that some sort of pedagogical kink should be given to chemistry,

[1] Crosby's "Training Courses for Teachers of Agriculture," p. 216.

[2] Consult "A Four Years' College Course in Agriculture." Circular 69, Office of Experiment Stations, Department of Agriculture.

or botany or even geography and arithmetic. Let these arts and sciences be taught from their own standpoint, with as direct application to as many affairs of real life as possible; but let chemistry continue to be chemistry, and let agriculture introduce new matter into the schools and with it a new point of view. Nor should this new matter be 'elementary agriculture.' In some ways I could wish the phrase had never been coined. What is wanted in our high schools is not elementary agriculture but elemental, fundamental agriculture. For this purpose we should select out of what is taught in our colleges not only those phases of agriculture which are adapted to use in the high school, but also those that strike at the root of farm life and its affairs — something that will appeal to real farmers and that will serve actually to educate their boys for the business of farming — soil physics, soil fertility, laboratory fields in crop production, the use of farm machinery, and the classification and principles of feeding of live stock." [1]

[1] See Davenport's "Education for Efficiency," p. 126. Chapter VII. of this book treats of "Agriculture in the High School," and an "Outline of Four Years' Work in High School Agriculture" is given, beginning on page 128.

In the common, non-technical high school, agricultural instruction will involve the knowledge and application of some of the principles of secondary botany, physics, and chemistry. Plant physiology, the ecology of domestic plants, the elements of horticulture, the types, conditions, fertility, and cultivation of soils, some of the more important physical and biological agencies in their relations to crop production, the different breeds and types of farm animals, the principles of feeding, the fundamental principles of dairy husbandry, plant diseases and insect pests, — together with methods of combating them, — farm machinery, farm buildings, and farm management, — together with the keeping of farm records and accounts, — will form the basis of instruction in secondary agriculture.[1] In the technical high schools and private secondary schools where a four years' course is offered, the work will be more comprehensive. Greater opportunities for practice can be given, and the students graduated from such schools will have a greater skill in connection with the

[1] Crosby's "Training Courses for Teachers of Agriculture," p. 216. See also Circular 49, Office of Experiment Stations, Department of Agriculture, entitled, "Secondary Courses in Agriculture."

work of the farm, and their education will be of a more technical nature.

The laboratory exercises and experimental field work will involve more of the fundamental principles than was possible in the elementary school. There should be experimental plots in connection with the school so that the scientific principles studied may be demonstrated in actual practice. Hotbeds, and coldframes, and a small greenhouse are indispensable. The student should be encouraged in experimental work at home and in the reading of the various agricultural bulletins and papers.[1]

It will thus be seen that a concise and exact definition of secondary agriculture is scarcely possible at this stage of its development. However, secondary agriculture lies between the agricultural nature-study teaching of the elementary school on the one side, and the advanced scientific agricultural instruction and investigation of the college on the other. Secondary agriculture is the study of the elementary scientific principles applicable to farming and farm life — and practice in such

[1] True's "Progress in Secondary Education in Agriculture," pp. 486–487. Yearbook, Department of Agriculture, 1902.

application. Principles that are elementary, or elemental, are not necessarily limited to the elementary school.[1]

[1] Brown, Elmer Ellsworth: "The Making of Our Middle Schools." Longmans, New York, 1903. On pages 1–6, Dr. Brown gives an excellent discussion of the general field of secondary education.

CHAPTER II

THE RISE AND DEVELOPMENT OF SECONDARY EDUCATION IN AGRICULTURE IN THE UNITED STATES

AGRICULTURE as a subject for secondary schools may now be considered as emerging from the experimental stage in this country. Its rise has occurred during the first decade of the twentieth century, though noteworthy beginnings were made before that time. Seventeen years ago, agriculture was not mentioned in the Report of the Committee of Ten of the National Educational Association, which was appointed to make an investigation of secondary school studies. The United States Department of Agriculture had little to say about secondary education in agriculture ten years ago. Instruction of a secondary nature was given in this subject to be sure, but it was practically confined to the agricultural colleges. The splendid agricultural high schools of to-day were just then beginning to come into existence. Country

life in the past has been, in the minds of most people, synonymous with drudgery. The appreciation of country life by the masses is of recent development. Before the opening of the present century, the tide of population has been cityward. Until recently the agricultural population generally has taken but little interest in the establishment, development, and maintenance of high schools. Country people have been content to send such of their children as they desired to educate somewhat better than they themselves were educated, to the nearest high schools. This policy has been followed at the sacrifice to farm and country life of thousands of the strongest and most intelligent youth of the land. The town and city schools included little or nothing designed to stimulate the art of agriculture or to encourage the choice of farming as a life work. Pursuits other than farming have been entered by these young people to the detriment of the agricultural interests of the nation, and many times to the detriment and folly of the young people themselves. The real significance of this has impressed itself upon the leaders of agricultural progress, and also upon the leaders in other activities and upon the statesmen of the nation.

Within the past few years scores of successful beginnings have been made in secondary agricultural education. On the one hand the agricultural colleges are leading in this movement, partly because they see that with the increase of pupils who study agriculture in the high school, their opportunities for securing a larger number of students will be increased; on the other hand the more progressive people of the rural communities are demanding that instruction in the science and art of agriculture shall be brought into closer contact with the communities in which they live. This can best be accomplished through the medium of local high schools. The effect of thus more widely disseminating a knowledge of the theory and practice of improved methods of agriculture is to turn the tide of sentiment, especially among the young people of the country, back toward the advantages of country life.[1]

The recent development in secondary agriculture has been along several distinct lines. In order to show the rise of this movement, and to make clear the present status of secondary education in agriculture, it will be necessary

[1] See A. C. True in Yearbook, Department of Agriculture, 1902, pp. 485–486.

(*Photo. by B. E. Mowrer.*)

THE FIRST BUILDING IN THE UNITED STATES DEVOTED TO MODERN SECONDARY EDUCATION IN AGRICULTURE.

Minnesota School of Agriculture.

to consider in some detail the different types of schools that are attempting this work.

I. The Agricultural College Type

The Minnesota School of Agriculture, which was established by the Board of Regents of the University of Minnesota in 1888, was the first distinctly secondary school in the United States in which agricultural instruction was given. This school is located on the grounds of the State College of Agriculture at St. Anthony Park, between the cities of St. Paul and Minneapolis, and is under the direction of the University. The reason for establishing the school may be learned by way of implication from the following quotation: "Observation and experience have shown that all the facilities afforded by the regular colleges of the country, for agricultural education, have failed to attract any large number of farmers' sons."[1] . . . Young men and women who are unable to pursue the full college course in agriculture are here given a practical education. The School offers a practical course of study designed to fit young men and young women for successful farm life, and aims to

[1] The University of Minnesota Catalogue for the year 1888–1889, pp. 86–87.

prepare its students for useful citizenship by training them in the work, the business, and the social life of the farm, the farm home, and the country community; and to interpret for them the life with which they are familiar. A scientific basis is provided for the proper management of the farm and the home through a knowledge of the underlying principles and processes.[1] The functions of the school are two, with special stress on the first: to fit young men and young women for successful farm life, and to prepare them for the college of agriculture. These aims are being realized with much gratification.

At first the course of study was two years in length, but later it was increased to three. Pupils of both sexes are admitted. The subjects taught are agriculture, manual training, and shop work for the boys; domestic science and some agriculture for the girls. The requirement for admission is graduation from the eighth grade of the elementary school. The enrollment is about seven hundred. The plan at St. Anthony Park has succeeded so well that the Minnesota legis-

[1] See the Circular of information of the Minnesota School of Agriculture for April, 1910, p. 5; also p. 8 of the University of Minnesota Bulletin, Vol. XIII., No. 4.

'hoto. by B. E. Mowrer.)

THE AGRONOMY CLASS AT WORK.

(Photo. by B. E. Mowrer.)

DAIRY CLASS WORK.

Sidelights on the work done in the Minnesota School of Agriculture.

lature established a similar school at Crookston in 1908, and at Morris in 1910.

Following the example of Minnesota, Nebraska, in 1896, established a similar secondary school in connection with the State College of Agriculture. At the present time courses in secondary agriculture are maintained in connection with the colleges of agriculture in Alabama, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Idaho, Illinois, Kentucky, Louisiana, Maine, Maryland, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, Nevada, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Porto Rico, Rhode Island, South Dakota, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming — thirty-five in all.[1]

2. The District Type

In 1895 an act of the general assembly of Alabama was approved which provided for the establishment of five agricultural schools in the first, fourth, fifth, sixth, and ninth

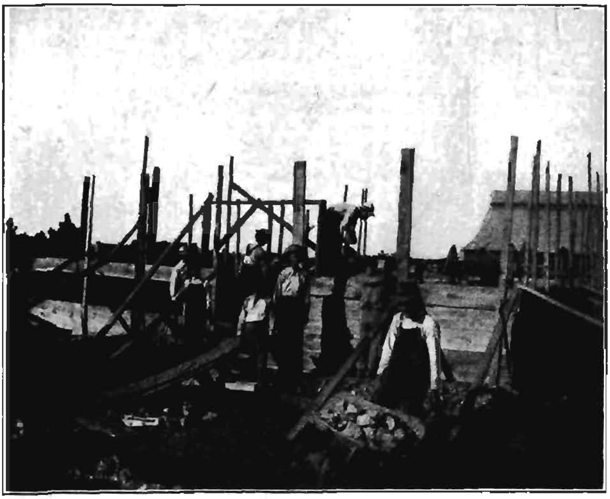
[1] Cf. True, A. C.: "The American System of Agricultural Education," Office of Experiment Stations, Circular 83, p. 21 (1909); also Circular 91 of the same office (1909).

congressional districts of the state. This act marked the consummation of a policy begun in 1889, when two agricultural schools were established — one at Athens and the other at Abbeville. An appropriation of $2500 a year was made to each of the first two schools established, which sum was supplemented by local funds. In 1907 the appropriation of the state for each of the agricultural schools was increased to $4500 a year. At first these schools were practically under local control, but since 1897 each school has been under the government of a Board of Control composed of the Governor, the Superintendent of Education, the Commissioner of Agriculture, the Secretary-Treasurer, and two progressive farmers from each district. While these schools give fundamental instruction in secondary agriculture, their curricula — which are four years in length — also include most of the subjects usually taught in the regular high schools. These schools are coeducational, and over 2000 boys and girls annually attend them.[1]

[1] See sections 59–69 of the Alabama Code of 1907; also "Secondary Agricultural Education in Alabama," by C. J. Owens. Bulletin 220, Office of Experiment Stations, 1909.

A CLASS JUDGING SWINE.

Eleventh District Agricultural School, Douglas, Georgia.



STUDENTS CONSTRUCTING A CONCRETE FOUNDATION FOR A BARN.

Eighth District Agricultural School, Madison, Georgia.

Some years later, the state of Georgia undertook the work of giving specific training to those of her citizens who are to engage in her chief industry, and toward this end has planned and established a definite system of secondary education in agriculture. She recognizes the vast importance of her undertaking, and the earnestness with which her people are devoting themselves to the task that they have set before them, gives assurance of a remarkable success. In 1906 the general assembly of Georgia passed an act that authorized the governor "to establish and cause to be maintained in each congressional district of the State an industrial and agricultural school in accordance with the provisions of this Act." The schools, of which there are eleven, are branches of the State College of Agriculture of the University of Georgia, and are under the supervision of its general board of trustees. Each local school is managed by a local board. As a condition of securing the location of a school, any county bidding for the same was required to donate to the state "a tract of land in such county, not less than two hundred acres, on which to locate a school for the district in which such county is located, to-

gether with any additional donation in the way of buildings or money." The people responded so enthusiastically that not less than $850,000 in land and money was offered and accepted, while the rejected bids amounted to fully as much. The annual income of each school is $6000.

The statute provides "That the course of studies in said schools shall be confined to the elementary branches of an English education, and practical treatises or lectures on agriculture in all its branches, and the mechanic arts, and such other studies as will enable students completing the course to enter the Freshman class of the State College of Agriculture on certificate of the principal." The resolutions adopted by the board of trustees of the University of Georgia thus interpret the statute: "The paramount object of these schools being the education of the pupils, both theoretically and practically, in the sciences of agriculture and the mechanic arts, and preparing them for citizenship, a curriculum should be prescribed that will include only those studies which are in their nature and tendency contributory to that end."

The program of studies is limited to four years' work, which includes agriculture and re-

lated sciences, English, mathematics, history; farm, laboratory and shop practice; domestic science, sewing, household economics, and kindred studies. The schools are coeducational. The minimum age for entrance is fixed at fourteen for males and thirteen for females. The total attendance of all the schools for the year 1908–1909 was 1001.[1]

Virginia in 1908, and Arkansas in 1909 provided for the establishment of similar high schools in each of their congressional districts. The Virginia act provides that not more than $20,000 shall be devoted to establish a department of agriculture, domestic science, and manual training, while the law of Arkansas appropriates $40,000 for each of her four schools.[2] The legislature of Oklahoma has provided for an agricultural high school in each of the judicial districts of that state.

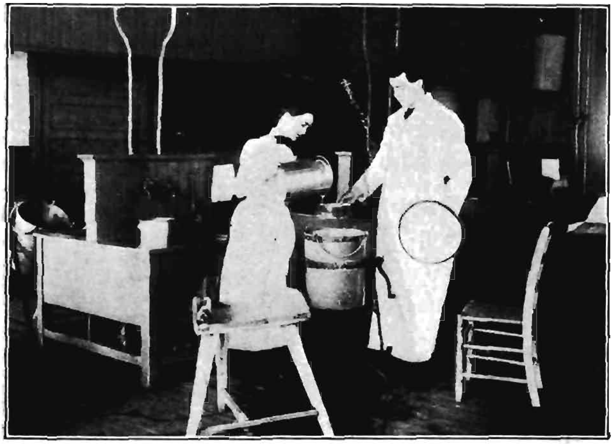
[1] Consult the December, 1909, bulletin of the State College of Agriculture, Athens, Georgia, entitled, "First Annual Report of the Congressional District Agricultural Schools of Georgia." See also Annual Report of the Office of Experiment Stations, Department of Agriculture, 1906, pp. 258–270.

[2] Report of the United States Commissioner of Education for 1909, Vol. I., pp. 146, 149.

3. The County Type

Honorable L. D. Harvey, former State Superintendent of Public Instruction of Wisconsin, is the father of the county agricultural high school. These schools are the result of a report made by him in 1900.[1] In this report Mr. Harvey says: "There has been for some time a steadily growing demand that provision should be made in the public schools for instruction in the principles of agriculture." Again, "in the work in agriculture thus far organized in this country, we are far behind foreign countries, both in the scope of the work attempted and in the extent to which it has been organized." He shows the need of agricultural training for secondary grades and then recommends that the legislature of Wisconsin "*provide for the establishment of county schools for instruction in agriculture and domestic economy*," and that the state aid to at least one-half of the sum actually expended for purposes of instruction in such schools. In the previous year the state had established

[1] Biennial Report of the State Superintendent of the State of Wisconsin for the Two Years Ending June 30, 1900. "Agriculture and Domestic Economy in Rural Communities," pp. 58–69.



A CLASS IN DAIRYING.

A CLASS IN COOKING.

School of Agriculture and Domestic Economy, Winneconne, Wisconsin.

county training schools for teachers, and the report recommends that these agricultural schools be established in connection with them. The legislature in its session of 1901 adopted these suggestions and passed a law authorizing the county board of any county "to appropriate money for the organization, equipment, and maintenance of a county school of agriculture and domestic economy," or "the county boards of two or more counties may unite in establishing such a school." The first schools were established under this act the following year at Wausau, Marathon county, and at Menomonie, Dunn county.

These schools in Wisconsin are by law under the general supervision of the State Superintendent of Public Instruction, who, with the advice of the dean of the College of Agriculture of the State University, prescribes the course of study to be pursued. The courses are two years in length and include subjects of general agriculture; biological and physical subjects; laboratory, field, and shop work; domestic science, home economy, and hygiene; farm management and accounts; sewing and millinery; besides courses in English, history, civics, and other branches of the usual high school type. The young men and the young

women pursue different courses, although they have many studies in common. Pupils entering these schools must be at least sixteen years of age and graduates from the elementary school. The state aids each school to the extent of $4000 a year, which sum is applied to the running expenses.[1]

In 1905 Minnesota passed an act providing for local option in the establishment and maintenance of county schools of agriculture and domestic science. Each school must possess not less than ten acres of land. The supervision of these schools is practically on the same plan as that provided for the Wisconsin schools. The county is limited to $20,000, the maximum which it may spend for this purpose in one year.[2]

In 1907 the people of the state of Michigan enacted a law providing for the establishment and maintenance of similar schools. Twenty-two sections of land were appropriated, the proceeds of which will be applied to this purpose.[3]

[1] Most of these schools publish bulletins to which the reader is referred for more detailed information.

[2] Annual Report, Office of Experiment Stations, 1905, p. 348.

[3] See pp. 131–132 of the General School Laws of Michigan, 1907.

Other states have been quick to see the significance of these schools, and now county high schools are authorized by Alabama, California, Colorado, Florida, Indiana, Iowa, Kansas, Maryland, Michigan, Minnesota, Mississippi, Montana, Nebraska, Nevada, Oklahoma, Oregon, Tennessee, Virginia, West Virginia, and Wisconsin, and in most of them are found good courses in secondary agriculture.

4. The Village-Township High School Type

Agriculture as a subject of secondary education is rapidly entering the curricula of the existing high schools throughout the country, and it is scarcely possible to chronicle the numerous instances.[1] A few examples only that will serve as types can here be given.

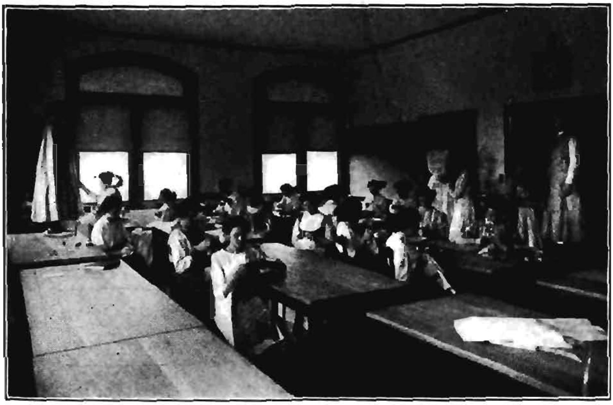
In Massachusetts separate agricultural schools of secondary grade are being established under the provisions of the act of 1906 that created the Massachusetts Commission of Industrial Education. The Smith's Agri-

[1] The Office of Experiment Stations of the U. S. Department of Agriculture, in its Circular 97, has given as complete a list as can now be secured of "Institutions in the United States giving Instruction in Agriculture" (1910).

cultural School and Northampton School of Industries, which was opened October 1, 1908, may be taken as an example. The city of Northampton[1] annually appropriates $20,000 towards the maintenance of this school, and, under the provisions of the act referred to, the state of Massachusetts pays one-half of this amount. The city is fortunate in this enterprise. About sixty-five years ago, Mr. Oliver Smith bequeathed a fund to the city for an agricultural school. This fund had accumulated to the amount of $310,660, which now aids in the support of the new industrial and agricultural school. "A large brick agricultural building has been constructed, and several buildings have been planned. The school farm consists of about one hundred acres of land lying on the outskirts of the city. The institution is coeducational, and at present offers three four-year courses of study, viz., a course to prepare for farming, a course to prepare for mechanical work, and a course to prepare for housekeeping and homemaking. There is no regular college preparatory course. Candidates for admission to the school must be at least fourteen years of age, and must

[1] A city of about 20,000 population.

A CLASS OF BOYS SPRAYING.



A CLASS OF GIRLS SEWING.

Agricultural School and Northampton School of Industries, Northampton, Massachusetts.

at least 'have the maturity of mind of the later grammar-school years.' No entrance examination is required; but the first weeks of school are regarded as a period of probation. Textbooks and tuition for local pupils are free." [1]

At New Holland, Ohio, a village of about one thousand people, a high school of the "first grade," under the school laws of that state is maintained. In 1907-1908 the curriculum was reorganized, and a course of secondary agriculture was included in the third year. The reason for instituting the course in agriculture is given in the following words: "The larger per cent of the boys and girls who are enrolled in the village and township high schools of this state will spend their lives either in the rural districts or villages where the farm life and the agricultural industries are the leading interests. They will either be farmers or farmers' wives, or they

[1] True, A. C., and Crosby, Dick J.: "The American System of Agricultural Education." Office of Experiment Stations, Circular 83, p. 23. See also the Report of the U. S. Commissioner of Education for 1909, Vol. I., pp. 146-147; and the handbook of information issued by the School, entitled "Smith's Agricultural School and Northampton School of Industries," 1910-1911.

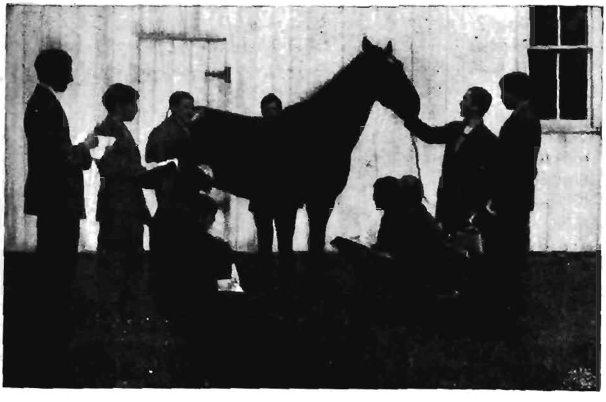
will be engaged in business very intimately connected with agriculture. In view of this condition, the board of education at New Holland, Ohio, has placed elementary agriculture in the curriculum of its high school." The course in agriculture is regarded as being second in importance to none, and its pursuance is required of both boys and girls. The new work at once became very popular. The village lies in the midst of a prosperous agricultural region, and in the next year after the course was introduced, the pupils who came from the outlying (country) districts made up over 30 per cent of the enrollment. "We find that this plan works very satisfactorily, and we hope that in the course of time, the wisdom of it will be reflected by the village and the adjoining country, and by the prosperity and happiness of the men and women who are now the boys and girls in training." Such is the estimation in which secondary agricultural education is there held.[1]

The consolidation of several rural schools of the old type into one centrally located

[1] See the Agricultural College Extension Bulletin for March, 1908. College of Agriculture, Ohio State University, Columbus, Ohio.

TESTING SEEDS IN THE LABORATORY.

New Holland High School.



JUNIOR HORSE JUDGING CLASS.

John Swaney High School.

school by transporting the pupils is one of the greatest modern improvements in the cause of general education for rural communities. The plan has made it possible for townships and rural communities to establish and maintain high schools of excellent grade, and in these we find growing up a strong sentiment for instruction in agriculture. There are scores of examples of this type of school, but only one may be briefly reviewed as an illustration. In 1906 the rural schools of Magnolia township, Putnam county, Illinois, were consolidated into one central school known as the John Swaney Consolidated School. The school takes its name from the farmer who donated a tract of land of twenty-four acres, upon which a two and one-half story, $12,000, brick school building now stands. About $2000 besides the grounds have been donated to this school by the enterprising citizens of of the township. The school is located in the country two miles from the nearest village, McNabb. It has excellent school equipments, gas and water plants. The high school program of studies is four years in length, and while many of the regular secondary school studies are scheduled, strong courses in secondary agriculture, household

science, and manual training are offered.[1] High schools of this type that emphasize the work in secondary agriculture are to be found in Massachusetts, where the plan of consolidation originated, Illinois, Indiana, Iowa, Kansas, Nebraska, Ohio, Michigan, Wisconsin, and to some extent in a few other states.[2]

5. The Private Secondary School Type

The rise and successful continuance of private institutions is a good index of the demands of society. If there does not arise a public institution to satisfy a social demand, enterprising individuals are ever ready to invest capital and labor for the purpose of satisfying that demand. The success of several secondary agricultural schools has already demonstrated that the people of the United States, especially the country people, keenly feel the need of giving their children an education with an agricultural, or rural

[1] Catalogue (1910–1911) of the John Swaney School, McNabb, Illinois. See also Crosby, Dick J.: "Progress in Agricultural Education," Report of the Office of Experiment Stations for 1908, pp. 277–283.

[2] Kern, O. J.: "Among Country Schools," p. 249. Ginn, Boston, 1906. Chapter XII. treats of the consolidation of country schools.

setting. The past decade has seen the rise of several private schools in which secondary agriculture and domestic science are the leading features. About 1900 such a school was opened at Briarcliff Manor, New York. It was established "to ascertain the public demand for an institution giving attention to the training of young men and women, especially of the cities, in the practice of agriculture, to enable them to obtain an independent livelihood and at the same time to develop a taste for rural life, by demonstrating that higher value may be obtained from land by intelligent management than under methods now generally practiced."[1] The regular program of studies covered a period of two years and was largely made up of scientific and agricultural subjects. The school soon outgrew its limited facilities at Briarcliff Manor. It was planned to move to a farm of four hundred twenty-five acres near Poughkeepsie, New York, but the officials in charge of the school, being unable to secure an adequate endowment, abandoned the enterprise. The history of this pioneer school shows that there existed a demand for education of this type.

[1] True, A. C.: Yearbook of the Department of Agriculture for 1902, pp. 494-495.

One of the most noted of these private institutions is the National Farm School, located at Farm School, Bucks County, Pennsylvania,—the nearest large town being Doylestown. This school was chartered by the state in 1896 "for the purpose of affording young men an opportunity to study practical and scientific agriculture for agricultural careers." There are ten buildings in connection with the instructional work of the school, besides several other buildings on the various divisions of the farm. The farm contains four hundred acres of land, of which three hundred and fifty are cultivated. The equipments are good, but the accommodations are limited to about one hundred boys. Applicants for admission must be above sixteen years of age, their mental and physical conditions good, and their scholarship equivalent to about the work done in the eighth grade of the average elementary school. Pupils are admitted from any state, and, while no creed is barred, most of them are of Hebrew descent.

The funds for the school are obtained from the interest of an endowment fund of $84,000, from state appropriations, from the Federation of Jewish Charities of Philadelphia and similar federations of other cities, from mem-

Class in Agricultural Chemistry.

National Farm School.

berships, bequests, and donations. Tuition is free; so also are board, clothing, etc., "excepting in cases where students are able to pay for these." In 1901 the state of Pennsylvania recognized the good work of this institution, and the legislature appropriated the sum of $2500 a year for two years for its use. More money has since been granted to this school from the same source. The school now receives more applications for admission than it can accommodate, and is obliged to keep a waiting list.[1]

The Baron De Hirsch Agricultural School at Woodbine, New Jersey, founded in 1891; and the Mount Hermon School, founded by the great evangelist, Dwight L. Moody, in 1881, near Northfield, Massachusetts, are two widely known of these private secondary schools that offer courses in secondary agriculture.

The foregoing are the principal types of schools that are giving instruction in secondary agriculture. There are several schools

[1] See Yearbook of the Department of Agriculture for 1902, p. 494; for 1906, p. 160. Bulletin No. 2, 1907, U. S. Bureau of Education, by James Ralph Jewell, entitled "Agricultural Education," p. 84. The Circular of Information of the National Farm School, 1910–1912. Farm School, Pennsylvania.

for negroes [1] and some for Indians that give instruction in this subject. The work of the Hampton Normal and Agricultural Institute, and that of Tuskegee Normal and Industrial Institute are too well known to require any description here. As there arises a demand for teachers of secondary agriculture, the normal schools, colleges, and universities are gradually organizing courses in secondary agricultural education to meet this demand. Many states are granting state aid to communities that establish secondary courses in agriculture and domestic science. One example will suffice. The legislature of Minnesota passed an act, which was approved in 1909, providing that schools that had satisfactory rooms, equipment, and instructors for teaching secondary agriculture might institute such courses and receive state aid for such instruction equal to two-thirds of the amount actually expended upon such a department.[2]

[1] Crosby, D. J.: "Instruction in Agriculture in Land-Grant Colleges and Schools for Colored Persons," pp. 719–749, of the Annual Report of the Office of Experiment Stations for 1903.

[2] Report of the U. S. Commissioner of Education, 1909, Vol. I., p. 148.

Thus, the work of education in secondary agriculture is rapidly advancing. Up to May 1, 1910, five hundred and sixty-six schools of secondary grade were reported as giving instruction in agriculture.[1]

"It is difficult now to keep pace with the spread of the movement for secondary instruction in agriculture in this country. The introduction of such instruction into the secondary schools is now proceeding so rapidly and so widely that the Office of Experiment Stations is no longer able to keep a complete current record of the progress. There was a time when we felt that we knew substantially all the institutions that were giving secondary instruction in agriculture. Now we are sure we do not." [2]

[1] Circular 97, Office of Experiment Stations.

[2] Office of Experiment Stations, Circular 91, p. 1.

CHAPTER III

THE SOCIAL RESULTS OF SECONDARY AGRICULTURE

FROM the preceding sketch of the rise and growth of secondary agriculture, it may readily be seen that this type of education and training has come to stay. So long as large numbers of our people are engaged in the tilling of the soil and the raising of domestic animals, so long as they shall be interested in the fundamental principles and facts that underlie these activities and the betterment of country life, — so long will there be a demand for instruction in the science and practice of agriculture.

The school should educate not only in terms of the best that exists in the society by which it is maintained, but also in terms of the ideals to which it is desired that the same society should attain. Thus considered, its function is not only preservative, but also directive; not only conservative, but also constructive. It should be a potent instru-

ment for intelligent reform and progress. In the past, the school has been organized to serve the community as a preservative and conservative force. In the early years of the past century society required educated preachers, doctors, and lawyers, and the schools of secondary grade were usually so constituted as to furnish society with these desired necessities. Doubtless, this function the school performed well; indeed so well, that its curriculum became crystallized to such an extent that men had begun to think that over this route alone might education and culture be attained. But the modern idea has arisen that the public high school must become to an ever increasing extent the efficient directive and constructive agent of society. We have come to realize that there are many avenues over which the youth may travel in order to become finally a cultured and serviceable citizen. The ideas of culture and education have changed, and the resulting new ideals have forced a revolution in school methods and subjects. The society in which the school began its growth has also changed, in the course of a century, from a society comparatively simple in structure to one that is to-day very complex. We are

to-day no longer content to have the secondary school lay the basis for the professions of the ministry, medicine, law, and teaching, merely. Other walks of life have assumed proportions equal in importance with these, and society has been justly and successfully demanding that courses be provided for giving a basic training for numerous other vocations to which the youth of the land aspire. There is no legitimate reason why this demand should not be granted. The school is supposed to be a democratic institution, maintained by a democratic society, and the principle upon which it may most successfully continue to operate is that it shall yield the greatest good to the greatest number.

Scientific and industrial studies have been finding their way to an ever increasing extent into the programs of our secondary schools. The colleges cannot reach the masses, and it is essential that the masses should be reached. This knocking of the industrial arts and sciences for admittance to a place in the curricula of our high schools is only a legitimate demand of our civilization. The school is not only maintained by society as a means through which to prepare its young for life, but it has come to be a

large portion of the experience of life. Ideally, the adolescent boy or girl should live in an elementary way the life that he expects to live more intensely later; and the more nearly the high school approaches this ideal condition, the better is the school. Hence, it follows that those who expect to follow a certain trade or calling later in life should secure the beginnings of the knowledge and experience of that trade or calling in the secondary school.

Education in agriculture is only one phase of this rising tide of industrial education and training. So strong has been the demand for this type of education and training, and so unable — or unwilling — have the regular secondary schools been to modify their organizations to meet the conditions of this new subject of instruction, that new and special secondary schools have been established and maintained to satisfy the new demand. We have already sketched the rise of these new schools. The questions which their rise has roused, — whether or not their maintenance will result in evil or good to the previously existing system of secondary education, and whether or not the effects upon the social order will be detrimental or beneficial, — remain unanswered.

The existence and maintenance of these agricultural high schools may become a menace to the regular system of secondary schools, especially if the former become competitive in their nature. It is alleged that the programs of study of these new high schools are exceedingly narrow in that they aim toward one vocation only, while many of the so-called cultural secondary subjects are omitted; that their curricula require only one-half to three-fourths so long a time to complete, thus placing a premium upon short courses and meager knowledge; and that the regular system of secondary schools is being deprived of needed funds, and thereby rendered less efficient in order to supply adequate funds for the new schools. These are very serious charges, the truth of which should be carefully investigated, and, if found true, an effort should be made to remedy the evils.[1]

It has also been pointed out that a danger to our democratic society lurks in these new secondary schools. It is alleged that "To

[1] Consult Frederick E. Bolton on "Agricultural High Schools" in School Review, Vol. 16, pp. 56–58; also, Arthur D. Cromwell: "The Agricultural High School," *ibid.*, pp. 198–200.

segregate any class of people from the common mass, and to educate it by itself and solely with reference to its own affairs, is to make it narrower and more bigoted, generation by generation. It is to substitute training for education and to breed distrust and hatred in the body politic. Knowledge is necessary to a just appreciation of other people and their professions and mode of life; with this only can a man respect his own calling as he ought and love his neighbor as he should. We cannot segregate and make an educational cleavage at the line of occupations, except to the common peril."[1] Our young people need to be educated and trained together so that those who are preparing for certain modes of life shall come into contact with others who are preparing for different modes of life and so acquire sympathy for other vocations besides their own. Boys and girls will thus have opportunities for developing tastes and modes of life for which they are best fitted, and which otherwise they would entirely miss. A boy born in the city

[1] Davenport's "Education for Efficiency," p. 150; also, Addresses and Proceedings of the N. E. A., 1909, p. 488. See Dick J. Crosby's answer to Dean Davenport's address on pp. 974–976 of the latter volume.

may, through contact with an agricultural course and pupils who are studying agriculture, develop the instinct to get back to Nature and through this influence become a successful farmer, while otherwise he might have become a pettifogging lawyer or a quack doctor.

These new agricultural schools are in a way a protest against the conservative organization of the regular system of secondary schools. One good influence which they will have upon the regular system is already apparent in the fact that the regular high schools are rapidly introducing courses of agriculture into their curricula either as an elective or a required subject. The colleges and universities are beginning to accept work in secondary agriculture among entrance credit, and the fact that agriculture properly taught is a cultural as well as a vocational subject is being more and more recognized among schoolmen.

There is, undoubtedly, a legitimate place in our society for these secondary schools of agriculture. A few should exist to satisfy the need of those boys and girls who do not possess the advantage of a local high school where agriculture may be pursued; for the

benefit of those persons who desire a more thorough training for future specialization in agriculture than the regular high school can give; and for those young farmers whose secondary education has been neglected, and who, later in life, desire to pursue short and practical courses that will aid them to farm more intelligently.

The time has come when the public high school must organize a more comprehensive program of studies, and lend a helping hand to all classes of adolescent boys and girls no matter what walk of life may be their choice, or their lot, provided they have attained a certain reasonable standard in elementary education. If the regular secondary system has been organized along lines that are narrow, the same criticism of narrowness may be applied to the new strictly agricultural and industrial schools. What is needed is a development, a broadening, of our present regular system of secondary schools so as to include all the best new features of the agricultural and industrial schools and retain all the good features of the regular system. There should not be duplicate systems; all secondary types should be under the same organization and management, and the funds

should go to the established order.[1] A great people with great and varied interests must have a secondary school system that shall be equally comprehensive. It must not only represent all the important interests of the society that maintains it, but it must also realize its social responsibility to the community. It must endeavor to relate itself to the whole life and welfare of the people and be one of the fountains from which good ideals, efficient service, and progressive social life flow.

Of course, all this development will require more funds, better equipments, professional teachers, elective courses of study, and perhaps an abridgment of elementary education. It will be necessary to educate and train adolescents without special reference to entering college, but to prepare them to some degree for the various callings of life that may be preferred by them. More latitude must be given by colleges and universities in their entrance requirements, and the liberalizing of the college curriculum must keep pace with the liberalizing of the entrance requirements. A limit to the number of subjects that may

[1] See Bailey, L. H.: "The Training of Farmers," pp. 167–168. Century Co., New York, 1909.

be offered towards satisfying the entrance requirements of a college or university is evidence that the institution requiring such restrictions is limited in the courses it offers and is, therefore, limited in its bid for students. The highest educational institution of the state should be both sufficiently varied and democratic to accommodate every pupil who is graduated from a first class four-year high school.

All that may be asked of the regular public secondary schools is that they recognize secondary agriculture as a subject equal in importance with the principal science or vocational subjects already included in their programs of studies. The principles of the science and art of agriculture may be made as truly educative as any of the regular high school courses. The study of agriculture in the secondary school is not meant to make specialists any more than is the study of Latin, or of physics meant to make specialists in these subjects. Only the basis is acquired, and the possibilities of the individual tested, for such specialization.

CHAPTER IV

SECONDARY AGRICULTURE SHOULD BE TAUGHT AS A SEPARATE SCIENCE[1]

THE past half century has seen the organization and growth of a great scheme of agricultural education. Out of the provisions of the Morrill Act, which became a law July 2, 1862, means were provided for the study and teaching of agriculture in the higher institutions of collegiate grade. But these institutions, although they have done admirable work, have not succeeded in meeting the practical needs of the people. This failure, through perhaps no fault of the institutions themselves, and certainly not attributable to a lack of willingness and energy upon their part, is nevertheless a fact, and this is recognized by both the agricultural colleges and the rural population. These higher institutions of learning are too far removed from the very people for whom they were instituted.

[1] See Education, Vol. XXX., pp. 352–356, where this chapter, with the exception of a few minor changes, first appeared.

From below, an effort to reach the country people through nature study in the grades and in the country schools cannot be said to have succeeded. It is very evident that the principles of agriculture cannot be successfully taught to pupils under the adolescent age, much less the way pointed out for their intelligent application. The high school alone seems to meet the requirements. This institution lies much closer to the rural population than does the college, and its pupils are of an age when they can be taught the more practical scientific principles involved in practice. The result is that the high schools are adopting agriculture either as an elective or as a required branch; where institutions of the secondary grade do not already exist, the "agricultural high school" is rising to meet the demands of the farming class.

Just now, with the agitation for securing a recognition for agriculture in the high schools, another problem is confronting secondary school men; namely, the successful teaching of the physical and the biological sciences. Statistics show that there is a falling off in the number of students taking scientific studies.[1]

[1] Report of the United States Commissioner of Education for 1907, Vol. II., pp. 1048–1052.

The testimony of secondary school men of experience indicates that the teaching of these sciences is not satisfactory, and the college professors who receive the graduates of the secondary schools are notoriously chronic complainers. Of course there are reasons for this state of affairs; but it is not the province of this chapter to discuss them, nor to propose remedies. We are now concerned only with a possible danger to successful secondary agricultural education.

It has been proposed, and is being advocated, that the sciences in the high schools be taught as applied sciences,[1] which, thus far, may be well; but it is further urged that the application be made to agriculture. In other words, it is proposed to tack the science and practice of agriculture to the various sciences of the high school as a sort of appendage to them.[2]

[1] Hall, G. Stanley: "Adolescence: Its Psychology and its Relation to Physiology, Anthropology, Sociology, Sex, Crime, Religion, and Education." Two volumes. Appleton, New York, 1905. See Vol. II., pp. 153, 156–157. Giles, F. M.: "Teaching Agriculture in the High School," School Review, Vol. 17, pp. 154–165.

[2] Main, Josiah: "Correlation of High School Science and Agriculture," Education, Vol. XXX., pp. 135–145.

It is against this proposal that we raise these words in protest.

A disposition has been apparent on the part of some who have undertaken the explanation of matters agricultural to treat them in a somewhat disconnected and poorly organized manner. They do not allow sufficient prominence to the fact that agriculture is itself a science. The various natural sciences, it is true, shed a glorious light upon the principles of agriculture, but we must be careful to discriminate between them and agriculture itself. There is danger in presenting the subject as though it were a patchwork or a mosaic composed of fragments of all the known sciences. While the agricultural teacher ought to be well instructed in the various sciences bearing upon agriculture, he ought not to forget that he has chiefly to do with a great central subject upon which other sciences throw their beneficent rays.[1] "Teaching agriculture is much more than teaching a conglomeration of physical and biological sciences. Educators are coming to see more and more clearly that agri-

[1] Wrightson, John: "The Principles of Agricultural Practice as an Instructional Subject." Second edition, pp. 1–2. Chapman and Hall, London, 1889.

culture is both a science and an art, and as a result, it is being taught in ways which are not strictly applicable to the teaching of the other sciences." [1]

There is even less reason to ask that agriculture be taught in connection with the other sciences of the high school than there is to insist that physical geography or physiology be thus taught. Numerous functions and processes considered in this latter branch can be explained only by demonstrations drawn from other sciences. The processes of digestion are explained by the applications of chemical and physical principles. The relation of the ocular function to light is explained by optics. The several classes of levers by which movement is obtained in the human body are ideas explained by physics. What science does not contribute to physiology as it is to-day taught in the high school? Botany, likewise, draws upon physics, chemistry, agriculture, bacteriology, and geography, and yet few will advocate correlating it to these related sciences at the expense of a separate place in the curriculum. It is

[1] Crosby's "Training Courses for Teachers of Agriculture." Yearbook, Department of Agriculture, 1907, p. 218.

desirable that the pupil secure a clear and organized view of agriculture as a science very intimately related to agriculture as an art. This will not follow from a piecemeal teaching of unassociated principles of agriculture. We do not say that the application of the principles of the physical and the biological sciences shall never be made to agriculture, but that the application shall not always be made, whenever possible, to this subject; the principles of these sciences may often be applied in other arts quite as well and with greater regard for the rights of the pupil.

So close a correlation of agriculture with the other sciences of the high school would necessitate a violation of the democratic principle that needs to be respected in these schools of the people.[1] In the schools where agriculture should be taught, at least as an elective branch, will be children who will in later life enter industries quite distinct from agriculture. Some will enter factories, some will become engineers, some will become interested in the mining industry, while others

[1] Carlton, Frank Tracy: "Education and Industrial Evolution." Macmillan, New York, 1908. See especially pp. 7–12, 316.

will enter any one of the various pursuits, all of which are modes of life quite as essential in a civilized society as is food production. To give every boy in the high school a bent toward agriculture would be a step as radically wrong as it is uncalled for. Every boy and girl in city and country should be so taught that if he be compelled to drop out of school to-morrow, his work up to the close of to-day's session would be such as to give him the best possible preparation for life. It is not giving a student a "square deal" to hold him so closely to an industrial education of a peculiar kind at this period of life. If agriculture be taught as a separate branch, then those students who do not wish to receive instruction in agriculture will be unhampered by a lot of agricultural material in the pursuit of the other sciences, while the boys who wish to study agriculture may do so without a violation of the rights of others and yet secure all the benefits of a course of instruction which they desire.

Another theory of those who advocate the teaching of agriculture in connection with the other sciences is that if this subject is not so taught, it must come after them. This theory is not substantiated by actual test.

The writer has successfully taught two high school classes in this subject, when the only science work that had preceded was a half year each of physiology and physical geography, and no other science course was taken at the same time. The average high school boy does not care to know the exact "why"; he wants no long, explicit statement of the exact physical causes that compel the water to pass through the tissue of the root hairs. He is rightly willing to defer that for a later period of his life. He now wants to see a process that will explain the matter to his own adolescent mind, and then he is ready for the practical application of the fact.[1] Men who have been long absorbed in science studies are often unable to see this point. A professor in a college of agriculture once asked the writer whether it was thought advisable to perform an experiment showing osmosis before a class of high school pupils who had never studied the principle in physics!

Agriculture, if taught as a separate science, will hold its own as a subject in the high school. Dr. A. C. True has conclusively shown that agriculture may be rightfully

[1] Cf. Hall, "Adolescence," Vol. II., pp. 153, 156.

considered as a science,[1] and that it possesses true educational value for the student.[2] It is also gratifying to see that a majority of men who have had actual experience in teaching the subject advocate its being taught separately. Out of seventy-two *questionnaires* sent to both secondary school men and to college professors, forty-eight "advised that agriculture in the high school be taught as a separate science," while only twenty-four "advised that agriculture should be correlated with other studies." On the other hand, if agriculture should be attached to the other sciences for the purpose of instruction, no one knows how soon the "attachment" would be lopped off, and the teaching of agriculture thus come to an end. Those who advocate its introduction into the high school should not allow their enthusiasm to be so easily satisfied with only a passing recognition. Agricultural illustrations in connection with the various sciences usually taught in the high school will never take the place of

[1] "The Science of Agriculture," Annual Report of the Office of Experiment Stations, 1902, p. 423.

[2] "Educational Values of Courses in Agriculture," Annual Report of the Office of Experiment Stations, 1902, p. 435.

the independent subject of agriculture any more than would medical illustrations in connection with college zoölogy, botany, and chemistry take the place of an independent medical course.

CHAPTER V

THE PSYCHOLOGICAL DETERMINATION OF SEQUENCE

THE many phases of agriculture that are desirable to present to the youth, and the apparent chaotic condition of the whole field from the pedagogical point of view, seem to necessitate the statement of some plan of procedure in the presentation of the subject that shall have a sound pedagogical basis. In working out methods for the teaching of any department of human knowledge, the fundamental consideration is the nature of the learner. We cannot modify the natural method of the child's development to any appreciable extent, so our problem lies in the right interpretation of that development, and in modifying the material to be used in such a way as to secure the most ready reaction on the part of the pupil.[1] The secondary

[1] Rein, Professor W.: "Outlines of Pedagogics," p. 169. Translated by C. C. and Ida J. Van Liew. Bardeen, Syracuse, 1895.

school pupil is in the transition stage of development midway between childhood and manhood. His intelligence is not yet fully developed, his experience is limited, and his knowledge, incomplete and unorganized. There is a pedagogical demand that there should be a psychological arrangement rather than a logical arrangement of studies for secondary instruction.[1] The logical arrangement is adaptable to adults who are matured with respect to developed intelligence, broad experience, and extended and organized knowledge.

From the psychological point of view there are four factors that enter into the problem of determining the proper sequence in presenting the various subjects and phases of agriculture to the secondary school pupil. These factors are: —

1. The apperceptive basis that the individual possesses in terms of previously acquired ideas and experience.

2. The characteristic instincts of the individual during the adolescent stage of development.

3. The economic sanction, which appeals to the pupil's desire for production and owner-

[1] Brown, Elmer Ellsworth: "The Making of Our Middle Schools," p. 412.

ship, and by means of which his serviceableness to the race may be enhanced.

4. The previously acquired habits in accordance with which the pupil adjusts himself to his environment.

I. The Apperceptive Factor

Apperception[1] is the perception of new things in relation to the ideas which we already possess. If one has many ideas on a certain subject, it will be easier to acquire new ideas with respect to it than if one has only a few ideas concerning it. This principle holds

[1] Apperception will be found fully treated in the following references: —

Lange, Dr. Karl: "Apperception: A Monograph on Psychology and Pedagogy." Translated by the Herbartian Club. Heath, Boston, 1894. Bagley, W. C.: "The Educative Process." Macmillan, New York, 1908, Part II., beginning with p. 66. McMurry, Charles A.: "The Elements of General Method." Chapter VI. The Macmillan Company, New York, 1907. De Garmo, Charles: "Herbart and the Herbartians," Chapter VII. Scribner's, New York, 1896. Rein's "Outlines of Pedagogics," pp. 118–120. Thorndike, Edward L.: "The Principles of Teaching," Chapter IV. Seiler, New York, 1906. See also Thorndike's "Elements of Psychology," sections 35–37, 42–45, 50.

equally true of both adults and children. But as interest partly depends upon the ideas already in the mind,[1] we may conclude that "apperception is based, primarily, upon interest."[2] It has also been shown that the more elementary process of apperception is based upon the primitive needs of the individual.[3]

The first interests that children manifest in nature, or in the things with which agriculture is concerned, are biological.[4] Animals and plants very early attract their attention. It is difficult to ascertain whether, in the majority of children of high school age, interest in animals or in plants predominates. Most children, however, upon entering the high school, have a more or less extended and

[1] Herbart, John Frederick: "The Æsthetic Revelation of the World." *Translated by Henry M.* and Emmie Felkin, in "The Science of Education." Swan Sonnenschein & Co., London, 1892.

[2] Bagley's "The Educative Process," p. 92.

[3] *Ibid.*, pp. 84–85.

[4] See C. F. Hodge in Pedagogical Seminary, Vol. 6, pp. 536–553; also in "Nature Study and Life," Chapter III. Ginn, Boston, 1902. Dopp, Katharine Elizabeth: "The Place of Industries in Elementary Education," pp. 110–112. University of Chicago Press, Chicago, 1903.

intimate acquaintance with both plants and animals. Most children have pets which enable them to acquire much definite knowledge and experience with a few animals. This knowledge and experience is usually increased by the pets of other children, the domestic animals of the farm, and the wild animals of the neighborhood. Likewise most children, especially those who are so fortunate as to be reared in the country or village, have experience in raising plants in their own gardens or in the family gardens, and the opportunities which they have for becoming acquainted with the many farm plants are very numerous. The school gardens of the cities are now giving to the pupils of the grades a much needed experience with and a valuable knowledge of the common garden and decorating plants. Not only will children, generally, have a good store of first-hand knowledge of plants and animals upon entering high school, but various agencies will have directed their reading along these lines. Many of the lessons in the readers of the grades are founded on nature studies, and the geographies used by the pupils contain many lessons on plant and animal life. The wide interest shown in nature study, and the

sustained emphasis that this subject continues to receive, bid fair to make it possible for every boy and girl of the elementary school to form an excellent basis that may be utilized by the agricultural instruction of the secondary school.

From the experience of cultivating the plants of the garden, and observation in the harvesting of the various crops of the farm, most children will have acquired a knowledge of the simpler garden tools, and a working basis for the study of the most complex farm implements and machinery.

Country children and most village children will know something about the more elementary ideas of farm management, — such as suitable places for the locating of buildings, the building of fences, the equipping of the farm with tools, machinery, live stock, etc., the employing of labor, the marketing of the farm produce, the securing of protection against loss by means of insurance, and the necessity for paying taxes in order to defray the necessary expenses of government. The simpler ideas along these lines will be readily grasped, and each may be expanded in due proportion.

About the subject of soils and other conditions of plant growth, children below the age

of fourteen know but little. The average boy knows in a sort of vague way, that manure and commercial fertilizers aid plants to make thrifty growth; that cultivation, somehow, assists plants to grow well; that moisture is necessary for plant growth; that weeds should be kept out of the crops; that the soil should not be plowed when too wet; that there is something in the rotation of crops, and a few other matters even more vague to his understanding.

Now, according to the principle of apperception, the high school pupil should be introduced to agriculture through that division of the subject concerning which he knows the most. Evidently this will be one of the biological divisions, — plants or animals. Since we are unable to determine conclusively, which of these divisions the average pupil upon entering the high school knows most about, and since we are certain that he is sufficiently familiar with either phase to furnish a good apperceptive basis and to inspire a healthy interest, it matters little, from psychological considerations, which of these divisions be chosen for the starting point in secondary agriculture. The working basis which children have of farm implements and

farm machinery will, perhaps, be somewhat more limited than that of the biological studies, and the ideas of farm management will also be more meager. On the other hand, it is quite evident that studies in soils and the other conditions of plant growth should be postponed, not only until the pupil has formed a better apperceptive basis for considering them, but also in order that the interests awakened by plant studies may create a strong desire to understand the fundamental principles concerning soil management and the vital conditions of plant growth.

The various topics within these great divisions of agriculture should also succeed one another in accordance with the principle of apperception. Those articles with which the average pupil is most familiar should be first selected for study, and these things will lead on to the consideration of other matters somewhat less familiar.

2. The Factor of Innate Dispositions

The period of adolescence in the individual is a period of very great and rapid development in both bodily and mental characteristics. It is a new birth as well as an age of reconstruction. At this age dormant instincts

are awakened, and old ones are emphasized.[1] Rightly used, these impulses may be wielded as powerful factors in the development of the personal powers of their possessor in laudable directions; but wrongly applied, they may be made the evil genii of his utter ruin. Our problem as schoolmen lies in the effort so to modify the instructional materials in the various subjects of the high school curriculum as to secure an agreeable and helpful reaction of the instincts of adolescence upon the individual.

We inherit neural organizations with paths of least resistance to external stimuli and their consequent reactions. A complex, organized system of stimuli and reactions, made possible by our inherited neural paths gives rise to instincts. An individual feels himself impelled to perform certain acts without knowing the end to be accomplished, yet as a result of these acts, a condition is attained which may better adapt the organism to its environment. Such activities are called in-

[1] See Hall's "Adolescence"; various chapters on adolescent growth, and especially Vol. I., p. 128, and Vol. II., p. 70 *et seq.* William H. Burnham on "Suggestion on the Psychology of Adolescence," School Review, Vol. 5, pp. 652–666. Hollister, Horace A.: "High School Administration," pp. 157–162. Heath, Boston, 1909.

stincts.[1] They furnish the original basis of education in man. We thus see that instincts furnish us with a biological basis for education.[2] They furnish fundamental avenues of approach to the growing mind; besides, through their activities, consciousness is first awakened, and the first raw materials of perception are brought to the mind.[3]

[1] "Instinct is usually defined as the faculty of acting in such a way as to produce certain ends without foresight of the ends, and without previous education in the performance." William James in "The Principles of Psychology," Vol. II., p. 383.

Kirkpatrick, Edwin A.: "Fundamentals of Child Study." Macmillan, New York, 1908. This is an excellent work on the development of instincts during childhood and early adolescence. Bagley, William Chandler: "Classroom Management, its Principles and Technique," pp. 14, 158. Macmillan, New York, 1908. Dewey, John: "Psychology," p. 353. Harper and Bros., New York, 1897. Baldwin, James Mark: "Dictionary of Philosophy and Psychology." Macmillan, New York, 1901. See the article under "Instincts." O'Shea, M. V.: "Education as Adjustment," pp. 154 *et seq.* Longmans, New York, 1907.

[2] Horne, Herman Harrell: "The Philosophy of Education," p. 24. Macmillan, New York, 1909. Chapter II. is entitled, "The Biological Aspect of Education."

[3] Royce, Josiah: "Outlines of Psychology." Macmillan, New York, 1903. See pp. 219 *et seq.*

Just as there are different periods in the life of the individual when certain parts of the body experience emphasized growth, so there are periods during which human instincts receive emphasized development. Some instincts develop during infancy, flourish for a time, and then cease to exist, as in the case of the sucking instinct;[1] others lie dormant for a time until the physical development has reached the proper stage when they gradually blossom forth in all their power.[2] Such instincts are called delayed instincts.[3] Many of these instincts develop and are particularly strong during the period of adolescence.

The first task before us, then, is to search out the dominant instincts of this period, to consider the characteristics of their functioning, to determine the results attained, and to demonstrate the nature of the stimuli that evoke them. The results of such investigation will enable us intelligently to organize the materials of secondary agricultural in-

[1] Cf. Bagley's "The Educative Process," p. 110.

[2] Kirkpatrick's "Fundamentals of Child Study," pp. 8, 44–46.

[3] Judd, Charles Hubbard: "Psychology, General Introduction," p. 215. Scribner's, New York, 1907.

struction in accordance with a definite aim, and by the application of scientific principles.

The dominant instincts in adolescents to which we may appeal by means of the instructional material of secondary agriculture are: æsthetic appreciation, activity, acquisitiveness, curiosity, expression, imitation, and manipulation. There are other instincts that may be enlisted in the work of instruction, but these are quite outside of our present field of consideration. Some of the above classes of instincts overlap others,[1] while some include others that are not here mentioned. For the purpose of clearness and utility, it is advantageous to make such divisions as are given.

Æsthetic Appreciation.[2] — During the adolescent period the development of the æsthetic instinct — the appreciation of the beautiful — becomes a potent factor in determining the activities of the youth. The attribute of

[1] Rowe, Stuart H.: "Habit-Formation, and the Science of Teaching," pp. 78–79. Longmans, New York, 1909.

[2] Rowe: "Habit-Formation," p. 77. Judd's "Psychology, General Introduction," p. 229. Kirkpatrick, Edwin A.: "Genetic Psychology," p. 104. Macmillan, New York, 1909. Also "Fundamentals of Child Study," pp. 209–212.

ugliness repels, the beautiful attracts. Upon this instinct depends the choice of friends, and the new instinct of love is guided in its expression and bestowal by some evidence of beauty in the object of adoration.[1] The child's contemplation of nature during this period is largely due to this instinct.[2] It is true that many of the highest forms of beauty, for example, in art and literature, are often beyond the child's ability to appreciate, and are entirely overlooked; but the harmonious mingling of the colors in flowers, the ripe fruit, the beautifully formed trees and bushes, the greensward, and the waving of grain — all these may be assumed to call forth pleasurable reactions in the normal adolescent. Such reactions give rise to a very strong interest[3] in the object whose æsthetic quality has awakened such pleasurable reactions.

[1] Consult Hall's "Adolescence," Vol. II., pp. 113, 139. An excellent contribution on the love affairs of adolescents is given in "Paidology," Vol. I., pp. 105–192. October, 1902. The editor is Dr. Oscar Chrisman, Ohio University, Athens, Ohio.

[2] See Hall's "Adolescence," Vol. II., Chapter XII., entitled, "Adolescent Feelings Toward Nature and a New Education in Science."

[3] In the classification of interests, Herbart names this the "æsthetic interest." Herbart, John Frederick:

Activity.[1] — The instinct of activity in the adolescent is very strong, though its functioning in the earlier years of this period is soon followed by fatigue. This instinct manifests itself in many ways, as in construction, expression, imitation, manipulation, play, etc. In the very early years of the individual his activities are very much at random (generally unorganized), but later they begin to become definitely organized with the result of a better adjustment of the organism to its environment. At this age of adolescence, the instincts become more certain as to their direction in response to external stimuli. The coördination of sensory impulses and corresponding motor discharges becomes more firmly fixed. There is a "hungering" for those forms of activity which result in pleasurable reactions. It is noticeable that those studies that require some form of activity are the ones most earnestly pursued by adoles-

"Outlines of Educational Doctrine." Translated by Alexis Lange and annotated by Charles De Garmo. Macmillan, New York, 1909. See Chapter V. and especially page 90.

[1] Hall's "Adolescence," Vol. I., pp. 158–165; Vol. II., pp. 75–76. Thorndike's "The Principles of Teaching," pp. 25–27.

cents, and the rapid rise of manual training, domestic economy, and agriculture as school subjects is traceable to the gratification of this instinct. In the arrangement of agricultural materials allowance should be made for the exercise of instinctive activity.

Acquisitiveness.[1] — The instinct of acquiring things for one's own lies at the basis of thrift. Its economic value is inestimable. In the earlier years of the individual it manifests itself in collecting[2] various articles, which may be mere trumpery, such as blocks of wood, broken dishes, etc.; nevertheless, a genuine pleasurable reaction is felt in their possession. To this cause may be attributed the fad of collecting stamps, coins, shells, birds' eggs, etc., which is so prominent in children just before and during the earlier years of adolescence. During adolescence the instinct of acquisitiveness gradually takes

[1] James, William: "The Principles of Psychology," II., 422. Holt, New York, 1908. Rowe: "Habit-Formation," p. 75. Thorndike's "The Principles of Teaching," p. 27.

[2] Burk, Caroline F.: "The Collecting Instinct," Pedagogical Seminary, Vol. 7, pp. 179–207. The same article will be found abridged in Hall, G. Stanley: "Aspects of Child Life," pp. 205–240. Ginn, Boston, 1907. Rowe: "Habit-Formation," p. 75.

the form of ownership of property, which can scarcely be classed as a primary instinct.[1] In the work of secondary agriculture this instinct may be very effectively used in such exercises as the collection of seeds, perfect fruits, cocoons, and specimens of various sorts.

Curiosity.[2] — Curiosity, or inquisitiveness, has been defined as "desire to know." It is an intellectual hunger or impulse to secure and test new sensations. In early life it is chiefly empirical, but later it develops into a contemplative (rational) phase. Curiosity thus develops interest and guides the pupil's attention to new laws and phenomena.

Very slight stimuli may, by awakening the driving force of instinctive curiosity, cause

[1] See Bagley's "The Educative Process," p. 198, and the same author's "Classroom Management," p. 168.

[2] James: "The Principles of Psychology," Vol. II., p. 429. Rowe: "Habit-Formation," p. 75. Hall: "Adolescence," Vol. II., pp. 85–86; also "Aspects of Child Life," "Curiosity and Interest," pp. 84–141. Kirkpatrick: "Fundamentals of Child Study," pp. 59, 168, 172; "Genetic Psychology," p. 102. Bagley: "Classroom Management," pp. 152, 153, 154. Angell, James Rowland: "Psychology," pp. 354–355. Holt, New York, 1908. Titchner, Edward Bradford: "An Outline of Psychology," p. 254. Macmillan, New York, 1896.

the youth to make very valuable discoveries. Curiosity under a given stimulus leads him to react in a certain direction. A new fact, object, or phenomenon presents itself and evokes instinct with pleasant, unpleasant, or negative results. If the result is unpleasant, the pupil will be repelled by the fact, the object, or the phenomenon that gives rise to the unpleasantness; if there is a negative result, *i.e.*, if the feeling aroused by the exercise of instinctive curiosity is neither pleasant nor unpleasant, the pupil's interest in the thing that evokes his curiosity will vanish, and he will no longer attend to it; but if the result is a pleasant one, interest will at once be aroused, and this condition assures attention. Therefore, to secure an effective interest and continued attention in the pupil, it becomes necessary so to present the materials of instruction that they shall result in pleasurable reactions to the instinct of curiosity.

Expression.[1] — The expressive instinct may manifest itself in many ways, as in speaking, writing, drawing, painting, making things, etc. Expression is the result of a revealing activity

[1] Rowe's "Habit-Formation," p. 76. Kirkpatrick's "Genetic Psychology," p. 106. Titchner's "An Outline of Psychology," pp. 22, 224.

of the mind. To do so, some form of muscular activity is involved. When the expression is successful, a feeling of satisfaction makes the form interesting. Care must be taken, therefore, that the forms of expression required shall not be too difficult in the beginning, else the expressive instinct will result in failure and unpleasantness. In such a case the consequent reaction would be disastrous to the development of the right kind of interest and attention.

A very potent phase of the instinct of expression is seen in the making of things. Constructiveness [1] is a very strong motive force in high school pupils. That boy is very unfortunate, indeed, who has no back yard or woodshed in which to construct chicken coops, weather vanes, rat traps, cider mills, bean hullers, martin boxes, telephones, etc. Normal boys and girls of adolescent years take great pleasure in making things, because the instinct of expression in this form results

[1] James: "The Principles of Psychology," Vol. II., p. 426. Rowe: "Habit-Formation," p. 75. Angell's "Psychology," p. 36. Kirkpatrick's "Fundamentals of Child Study," pp. 207–208, and "Genetic Psychology," pp. 102–103. Bagley's "Classroom Management," pp. 155–156.

in pleasant reactions. The direction that expression will take is fundamentally influenced by the environment in which the individual is placed. The city boy will express himself very differently from the boy reared in the country. The latter may very naturally be led to express himself through the medium of a well-kept garden or fields of grain, or the care and development of a superior grade of animals. This expressive instinct may easily be provided for in the teaching of agriculture, because of the abundant opportunity afforded for practice work.

Imitation.[1] — "Imitation is the tendency of the individual to act upon the suggestion of others." [2] This instinct begins to manifest

[1] An excellent discussion of imitation will be found in Horne's "The Philosophy of Education," pp. 175 *et seq.* James: "The Principles of Psychology," Vol. II., p. 408. Rowe's "Habit-Formation," p. 74. Angell's "Psychology," p. 360. Kirkpatrick's "Fundamentals of Child Study," Chapter VIII., discusses the different kinds of imitation; "Genetic Psychology," p. 101. Haskell-Russell: "Child Observation; Imitation," Boston, 1897. See also Tarde's "Laws of Imitation," New York, 1903, for a general treatment of imitation.

[2] Horne's "The Philosophy of Education," p. 176. Cf. Kirkpatrick's "Fundamentals of Child Study," p. 58.

itself in the individual about the ninth month after birth and continues to function throughout life.[1] The instinct of imitation is a powerful factor in society. It is especially strong in high school pupils, who often acquire the characteristic actions and peculiar methods of expression from their teachers and companions. The adolescent learns more through imitation than is commonly admitted. At no age are " fads " carried to such extremes, and this characteristic is explainable on the basis of the instinct of imitation. " Now, let me see if I can do it," is a familiar expression heard in the high school laboratory, which frequently implies willingness to learn by imitation. A good use of this instinct may often be made in laboratory practice.

Manipulation.[2] — When a new object is brought to the attention of a boy, one of his first impulses is to handle it. This he does with the manifest result of ascertaining its structure; of determining its weight; of secur-

[1] Baldwin, J. Mark: "Mental Development in the Child and the Race." Second edition, p. 124. Macmillan, New York, 1906.

[2] Rowe's "Habit-Formation," p. 76. Kirkpatrick's "Genetic Psychology," p. 299. Thorndike's "The Principles of Teaching," p. 26.

ing tactile impressions; and, in general, of securing a more complete concept of the object. The expression, "Let me see it," so frequently used by adolescents, means more than a mere ocular examination of an object. A new ball, a new tool, or some familiar object of a slightly different pattern is at once "tried" to ascertain if it can be used, or to see how it works; a new adjustment is thus secured. The new adjustment caused by a new tool of a slightly different pattern may, if it result in a pleasurable experience, awaken a lively interest in the pupil. The instinct that prompts to manipulation may be appealed to by those tools and implements which the pupil already knows how to use, and then other tools of different pattern may be gradually introduced.

In the preceding brief discussion of the various types of instincts that may be utilized in secondary agricultural instruction, it has been suggested in each case how the particular instinct might be utilized. These various instincts are evoked by the stimuli from material objects, hence the necessity of basing such work upon the laboratory method.

Not all of these instincts are capable of being appealed to at the same time, but one

or more of them may be utilized in conjunction with the other factors that determine the sequence of the materials of agricultural instruction. The object is to insure a pleasurable reaction that shall engender interest. Interest begets attention, and attention is the mother of knowledge. It must not be inferred, however, that every pleasurable reaction to instincts leads in the right direction; such a reaction may be the first step in a series which ultimately leads to ruin.[1] These reactions must be guarded against so far as possible in order that they shall not crystallize into bad habits. The trend of the initial reaction must always be upward to secure the sanction of the true educator.

3. The Economic Factor

Biology, with its emphasis upon the adjustment of the physical organism to its natural environment, places the practical at the bottom of existence.[2] The first thing is to exist, to live, and this is a very practical

[1] Cf. Bagley's "The Educative Process," pp. 101 *et seq.* Thorndike's "The Principles of Teaching," p. 28.

[2] O'Shea, M. V.: "Education as Adjustment," especially pp. 76–78.

matter. After man has met and satisfactorily solved this fundamental condition, he may proceed to the consideration of the more delicate modes of adjustment of civilized life and the pursuit of ideal ends. But these ideal ends must themselves in some way contribute to the problem of living in the wider sense of mental appreciation, if not in the narrower sense of physical existence, or they may become mere phantasms.[1] The ideals of life thus receive a practical sanction, because they assist human beings to make better adjustments to their environments — either natural or artificial. Without such a reason for their existence, they are not worthy of pursuit and should be excluded from the educational system maintained by the people. Education must be in constant touch with life. The logical conclusion of this view is that education prepares the individual for more efficient service in the more comprehensive sense of the term "service."

It has been shown that during the first years of adolescence children think of things in terms of their uses.[2] The growing motor

[1] Cf. Horne's "The Philosophy of Education," p. 53.

[2] Barnes, Shaw, and Kratz, as mentioned by Hall in "Adolescence," Vol. II., p. 486.

ability, the increased knowledge of what is regarded by others as worth while, his enhanced knowledge of commercial values, and a feeling of his responsibility as to the success of his own career, lead the adolescent to a consideration of the economic ends to be gained by his activities.[1] At this age the idea of utility begins to dominate thought. A new tool or machine, to hold the interest of a high school youth, must have some perceptible relation to practical affairs, if it is to hold his interest. The fact that an object has some use is to him a sufficient excuse for its existence. "Then, and not earlier, come the need of utilities, application of machinery, hygiene, commerce, processes of manufacture, the bread-winning worth of nature knowledge, how its forces are harnessed to serve man and to produce values. Contrary to common educational theory and practice, the practical, technological side of science should precede its purer forms. Here belong economic botany and zoölogy, the helpfulness of astronomy, the inventions that follow in the wake of discovery, machinery, and engineering novel-

[1] Keith, John Alexander Hull: "Elementary Education, its Problems and Processes," pp. 99–100. Scott, Foresman, Chicago, 1907.

ties based on researches — or, in a word, how man has made nature work for him." [1]

The instinctive activities of adolescence will normally result in pleasure simply from the instinctive craving for activity. But out of most of the various instincts discussed in the previous section very strong economic interests develop during the adolescent age. This being the case, the pleasurable reaction is obviously enhanced by the perception of the economic value of any activity. Thus there arises a double sanction: one from the side of primary instinct and the other from the side of reason.

The result of æsthetic appreciation may or may not contribute directly toward an economic end, but the acquisition of any special power in this direction is frequently economically applied. This interest, coupled with special power of expression by means of drawing, is of great economic value to the nature artist.

Curiosity may result in economic significance. If some practical and useful idea or object is gained, the pupil feels the glow of satisfaction, and a favorable attitude to the particular situation or fact in question is likely to develop.

[1] Hall's "Adolescence," Vol. II., pp. 153–154. See also Vol. II., pp. 150, 156–157.

The constructive instinct may be emphasized by leading the pupil to see that the result of certain activities may possess economic value.

How economic considerations emphasize imitation may be seen in daily life on every hand. If one farmer secures a better crop of corn because he cultivated it during a drought while his neighbors did not, the neighbors will likely follow his example from economic motives during the next dry season. The production of economic results is often accompanied by imitative acts.

High school pupils have a clear conception of the relation that exists between certain activities of the farm and the production of economic materials — food and clothing. The average boy who is given a garden of his own, and who is assured that the proceeds from its produce are to replenish his own purse, will cheerfully apply himself to the art of cultivation. The mere collecting instinct of the child develops into the deep-seated desire of ownership of property in the adolescent. He collects articles that possess an economic value. Many things are saved because they may sometime "come in handy."

The mainspring of modern commercial activity is traceable to the desire of ownership.

The result is the acquisition and the production of property. Productive labor comes to be utilized. Effort is not measured by the hands of the clock when an individual's interest has been awakened and is sustained by this instinctive desire. The shop laborer may begrudge the service that he gives after the whistle blows, until he becomes the owner of the shop. The boy on the farm will develop a greater interest in its activities if he owns a share of it, or of its produce.

We thus see that when consciousness, purpose, and reason modify these instinctive activities, the economic factor becomes a strong directive force. The result of the individual's *activity* is the attainment of some advantageous position or adjustment, or the acquisition of some economic object. He often secures these through the *imitation* of the actions of others. He is *curious* to discover something new and useful, and by *manipulation* he ascertains what that usefulness may be. In *expression* he satisfies his own desires or constructs to administer to his own usefulness. He *acquires* objects through collection and production, which contribute to his own personal enjoyment.

Since the economic factor is so strong a compelling force in awakening and accelerat-

ing the learning process in the adolescent, there is every reason why the place to " take hold " upon any phase of agricultural instruction should be where the economic sanction is most evident. This appeal to the primitive interests should not be regarded as the ultimate end to be reached. It only serves as a means, as a starting point, through which more remote ends of education may be the more easily attained. From this point we must gradually proceed to higher orders of interest,[1] to loftier ideals, and to the ability and desire to render more efficient service to one's fellows.

4. The Factor of Acquired Dispositions

One of the most potent factors that determines the functioning of the individual is his previously formed habits. If we know the habit and the stimulus under which it has been developed, we can predict with a reasonable degree of certainty the activity of the individual when the given stimulus is presented to him. One would indeed rarely fail to predict correctly what the activity of a ball player would be if a ball were tossed at him. Likewise, one would be astonished

[1] Bagley's "Classroom Management," pp. 168–169.

should a farmer boy, upon being presented with a hoe, proceed to split wood with it. The sight of the moving ball would excite the motor actions necessary for catching it, and the hoe would furnish the stimuli that would put into operation a set of muscles necessary for cultivating with the implement in question. The ball player might dodge the ball and allow it to pass on, but that would be the exception; and the boy might attempt to balance the hoe on the end of his chin, but that would not be the natural result.

"Habit is an acquired aptitude for some particular mode of automatic action."[1] It differs from instinct in that an instinct is inherited, while a habit is an organized reaction built up in the course of the individual's lifetime.[2] From this standpoint a habit may be defined as that mode of behavior which depends upon individual experience.[3] Habit, then, is the mass of automatic reactions built

[1] Rowe: "Habit-Formation," p. 47. James: "The Principles of Psychology," Vol. I., Chapter IV., entitled "Habit."

[2] Bagley's "Classroom Management," p. 15.

[3] Judd's "Psychology: General Introduction," p. 216. See Bagley's "The Educative Process," Chapter VII., for an excellent discussion of "Experience Functioning as Habit."

up during the lifetime of an individual. It results upon the successful accommodation or adaptation of the organism to its environment.

Habits are primarily dependent upon instincts, which furnish the original impulses that are finally built up into automatic action by repetition.[1] Instincts are not always adequate to the needs of life; these impulsive activities must be selected in the light of experience, organized and automatized, — in other words, instinctive activities must be modified and translated into habits, which adapt the individual to conditions for which mere instinct is inadequate.[2] A very important function of education is the formation of good habits; that is, regular and serviceable reactions to life's stimuli.[3]

We may classify habits into two classes: first, those that concern the purely mental activities; and second, those that have to do with automatic motor action.[4] In the first

[1] Judd: "Psychology: General Introduction," p. 216. Rowe: "Habit-Formation," p. 70. Royce: "Outlines of Psychology," p. 220.

[2] Cf. Bagley's "Classroom Management," p. 110.

[3] Horne's "The Philosophy of Education," pp. 54–55.

[4] Cf. Rowe's "Habit-Formation," p. 47.

class, stimuli excite and develop certain brain paths, and succeeding stimuli tend to arouse the same thought or thoughts.[1] People thus fall into the habit of thinking in the same way that they have previously thought, *i.e.*, one thought gives rise to a thought or a series of thoughts, which always follow in the habitual order. Again, a certain stimulus may habitually give rise to a certain idea. The stimulus, 2 + 2, may be depended upon to give the idea of 4 to those who have dedeveloped the habit. Still again, certain stimuli may awaken an habitual mental process or an habitual mode of thinking. A lumberman looks at a tree, and his thoughts concerning it are of an economic nature; an artist looks at the same tree, and he thinks of it in terms of its æsthetic qualities. The minds of both men function in their habitual ways; the results are very dissimilar, though the stimulus is identical in either case. Thus the mental law of apperception depends upon habit. But we are chiefly concerned with the second class of habits, — those that involve motor response.

[1] Royce: "Outlines of Psychology," pp. 66, 198. Andrews, B. R.: "Habit." American Journal of Psychology, Vol. 14, pp. 121–149.

It is well known that habit and perception develop together; one is the handmaid of the other. Correct perceptions tend to guide the organism in the development of good habits, while the organism's habits have a clarifying influence upon perception. The development of organized perception and of organized activity always go hand in hand. The automatisms by which the bodily adjustment to the hoe is gained, give the boy a much better idea of hoeing than he would otherwise have. "The training of eye and hand in any technical art, of ear and vocal cords in singing or speaking, of ear and hand in playing a musical instrument, go together in practical experience. The expert in every line not only acts more skillfully, but he sees or hears more skillfully and comprehensively. Perception is discriminate and complete just in so far as the factors of experience are organized into wholes appropriate for individual reaction." [1]

Habits may also be made the basis of interest. The essential condition of habit formation is that the reaction from the movement that it is desirable to automatize be a

[1] Judd's "Psychology: General Introduction," p. 175.

pleasurable one; otherwise, the habit may not be formed.[1] Pleasure from the execution of acquired dispositions is as natural, therefore, as pleasure from instincts.[2] Besides, habits develop propensities to activity in some certain direction upon the presentation of a given stimulus. There is always a feeling of naturalness in the performance of habitual acts, but if the acts are inhibited and the habit is not allowed to follow the stimulus to which it is accustomed to respond, there is a feeling of *unnaturalness*, — a genuine discomfort.[3] This pleasurable reaction may be made the basis of interest. The automatisms developed in learning to milk may be made the basis of interest in the principle and the construction of the milking machine. The automatic movements accompanying the tying of an ordinary knot contribute the most vital element in the interest manifested in learning to tie other knots, such as the weaver's knot, or the bowline knot. The motor habits of spading will contribute an element of interest in learning how to dig a ditch.

[1] Kirkpatrick's "Genetic Psychology," pp. 113–115.
[2] Judd's "Psychology: General Introduction," p. 228.
[3] Rowe: "Habit-Formation," p. 35.

Old habits hold somewhat the same relation to new ones as ideas already in the mind hold to new ideas. The formation of a new habit will be modified by the habits which the organism has already formed. "In any given situation the thoughts, feelings, and *acts* manifested will be those to which instinctive tendencies, or capacities, and also *previously formed habits* impel one." [1] In learning to tie a sheaf of wheat, one's movements will be modified by the previously automatized movements of the muscles now concerned. The automatisms acquired by lacing one's shoes, tying one's necktie, braiding, etc., will facilitate the acquirement of the automatic movements in learning to make the splices of ropes. Thus, in a measure, new habits are developed out of old ones.[2]

The subject of habit-formation is one that has not been extensively written upon, and the idea of developing a systematic series of habits, *i.e.*, automatic actions, to be acquired

[1] Thorndike, E. L.: "Elements of Psychology," pp. 199–204. The italics are our own. Seiler, New York, 1905. Cf. also Kirkpatrick's "Fundamentals of Child Study," pp. 82 *et seq.*

[2] Rowe: "Habit-Formation," p. 71. Royce: "Outlines of Psychology," pp. 231–235.

by pupils in a given course of instruction is of quite recent development in educational science and practice. In the present status of habit training in the elementary school, pupils enter the high school without any adequate uniformity in the automatisms that they have acquired. It is true that a class of pupils often do possess many automatisms in common, but until greater progress is made in systematic habit training in the elementary school, the high school must content itself with using such automatisms as its pupils have incidentally acquired, or assume the responsibility of first developing those habits that it wishes to make use of in later instruction.

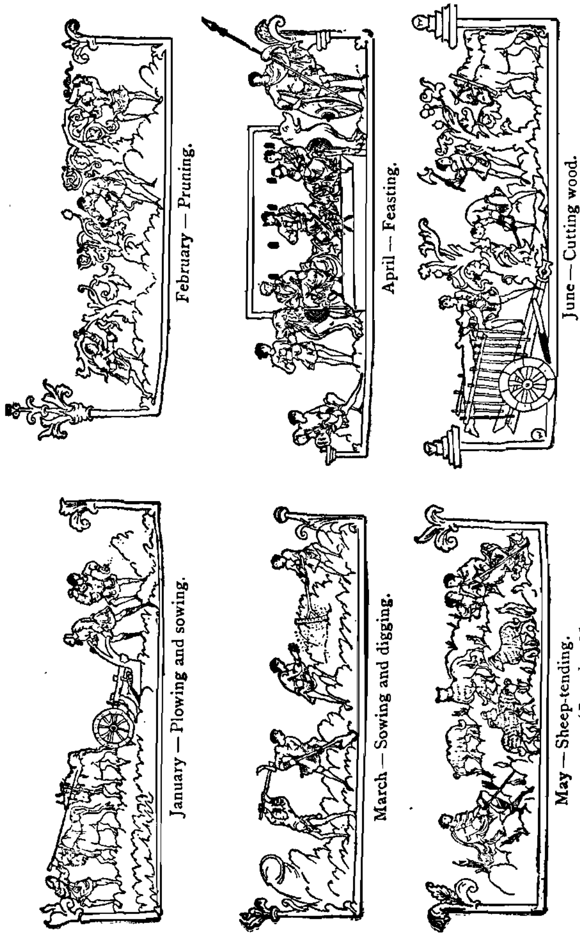
The habits that high school pupils have previously formed bear a very important and close relation to the organization of the materials for secondary agricultural instruction. Previously acquired habits very fundamentally influence future acts. Habits are stable and lasting to a degree quite equal to that of instincts and far greater than that of ideas. If ideas and instincts are sufficiently important to be considered as determining factors in the organization of teaching materials, we see no reason why habits should not also be so admitted.

CHAPTER VI

THE SEASONAL DETERMINATION OF SEQUENCE

In our zone most of the phases of agriculture are dependent upon the various seasons. Spring and seedtime, autumn and harvest are ideas that have been associated with each other for ages. Plant life, generally, is deeply influenced by these cycles of the year; and as plants bridge the gap between the inanimate earth and animal life, the activities of animals, even man, are profoundly modified by these periodic activities and dormant states in the vegetable world. Those animals most directly dependent upon plant life for existence are most directly influenced in their habits and activities. That class of men that is most closely related to plant and first food production is likewise most vitally influenced. The agriculturists compose this class.

The importance of keeping pace with Nature in her seasonal progress with all our agricultural activities is a very ancient idea. One thousand years before Christ, the Greek



(Reproduced by permission from S. R. Gardiner's "Student's History of England." Longmans, Green & Co.)

Rural Life in the Eleventh Century. January to June.
(Cott. MS. *Julius A. VI.*)

poet, Hesiod, set forth the necessity for such observance in his great poem, "Works and Days."[1] This is a lesson which the race has always had to keep in mind, and failure in its strict observance in agricultural practice has often caused the appearance of the "wolf" before the peasant's door in the depth of winter, and even Death has gone stalking through the land. Even in these modern days, with all our superior methods, there are examples of farmers in almost every community who persist in "bringing up the rear." Their usual rewards are great labor and small returns. This is a lesson which the young farmer needs to learn — the inestimable lesson of punctuality.[2] We thus see the importance of a seasonal sequence from the standpoint of the agriculturist. Our next step is to ascertain if a pedagogical use may be made of this fundamental requirement.

The school year in the United States begins

[1] Anderson, Robert: "The Works of the British Poets." John and Arthur Arch, London, 1795. Vol. 13, pp. 4–38. This is an old translation accompanied with rather copious notes.

[2] Main, Josiah: "Some Factors in the Making of a High School Course in Agriculture, II. The Seasonal Requirement." Education, Vol. XXX., pp. 220–225.

about the first of September and ends the latter part of the following May. There are two periods during this time when the seasons will permit the study of plants — the spring and the fall. In botany, studied from the standpoint of pure science, the study of the living plant is usually reserved until the spring months; but viewed from the applied science approach, and from pedagogical considerations, this custom is seriously questioned as being conducive to the best results. This point will be further considered hereafter.

If the work in secondary agriculture is begun immediately upon the opening of school in September, it is possible to begin with the study of plants. There are phases of plant growth that need to be emphasized at this season. Seeds need to be selected at harvest time, careful storage of grain and fruit should be considered, and the reasons for such procedure explained and demonstrated; damaged fruit that might have been saved may be examined, and the methods of preventing such damage considered. To this season belongs the judging of the matured crops of all kinds, and a genuine interest in and a desire for superior fruitage will be in-

culcated at the start of the course when it will most contribute to the real success of the study.

Animal studies may very appropriately begin after the convenient plant materials have been somewhat exhausted, and the cold winter weather has set in. The farm animals are now sheltered, and, if they are not, the importance of so caring for them may readily be pointed out. The principles of feeding and the effect of rations may be applied to better advantage now than at any other season, and the results of such demonstrations will be more striking and lasting. There will be especial opportunity for emphasizing the necessity as well as the desirability of the principles of sanitation in connection with the housing of animals. The fundamentals of dairying and the principles of poultry raising may be nicely adjusted to the school program, and the advanced winter prices of animal products will serve to emphasize the increased cost of winter care and the desirability of an increase in the production of these articles.

The latter part of the winter season is a period during which there is a lull in the outdoor activities of the farm. Harvest time is

past, and seedtime has not yet come. It is the end of the year for the farmer; it is his rest period, his day of leisure when the demands of his calling are not so exacting as usual, when he and those of his household may enjoy the luxuries of his calling — the accumulated fruitage of the year. But the wise farmer will not waste his time even now. Another year is coming, and plans must be worked out for future agricultural operations. These latter weeks of winter afford an excellent opportunity for the study of farming implements and machinery. These are the days when tools and machinery should be inspected, repaired, cleaned, and oiled, if necessary, in order to prevent rust and decay. Machine studies may well be followed by studies in general farm management. Every good farmer works in accordance with plans more or less flexible. The class in agriculture should now consider such things as systems of crop rotation, the plotting of orchards, plans for buildings and the elements that constitute desirable locations, the different kinds of fences and the principles of fence construction, various improvements, the cost and management of labor, insurance, taxes, farm accounts, etc. All these things are very

essential to success, for a farmer needs not only to know how best to produce wealth, but also how subsequently to manage and conserve it.

Before the bursting of the buds of spring, the attention of the class in agriculture must be turned to the consideration of soils. The effects upon soil of freezing and thawing may be made very evident at this time of the year. The physical characteristics of the soils, their behavior and actions under varying conditions, may be studied in the laboratory quite as well as in the field, or even better, since these conditions may be regulated at will; hence, it is not necessary to wait for the season of cultivation in order to begin this phase of the work.

The plant studies of the spring are not, from the standpoint of the agriculturist, essentially studies of the plants merely, but studies of the conditions of plant growth. The aim is to determine the conditions under which plants will thrive best, and then seek the true explanation of these reasons, so that the principles deduced may be remembered and later applied to actual agricultural practice. The study of soils thus becomes vitalized by the dependent condition of plant life. Insect studies now come to be of great concern, be-

cause the danger from insect pests to plant life, fruit, and grain noticed during the preceding fall becomes imminent. The principles that were learned in the laboratory may now be applied; fertilizer tests may be started and carried forward; the principles of cultivation may be studied and demonstrated; and scientific farming becomes a reality. Thus the knowledge that has been acquired throughout the school year becomes a living experience, a practical benefit, a source of profit, and, best of all, makes the youth capable of rendering the highest possible service in his profession to mankind.

A little reflection will reveal the fact that there are agricultural subjects to be considered that do not seem to fit into this general plan; that the seasonal sequence will not everywhere coincide with the apperceptive sequence. In accordance with the principle of seasonal sequence, whip grafting, for example, should be taught in the winter months when it is most convenient for the farmer to do that kind of work. Gardening under glass should also begin in late winter; early plants should be started, pot cultures grown as demonstrations, cuttings studied and made, and other work usually included under this

head should be carried on. Procedure in strict accordance with the principle of apperceptive sequence would seem to require the consideration of these things at other times, but it will readily be observed that these seeming exceptions may readily be adjusted, and they do not in the least invalidate the plan nor make it less serviceable.

There are three important advantages to be gained by compliance with the seasonal determination of sequence. (1) Materials will always be on hand or easily procurable, and the delays so often experienced from this source in secondary science instruction will be obviated. (2) The community interest will be at its height in each particular phase just at the time when the pupils at school are studying it. This will enlist the aid of the parents and the community in general, and a course in secondary agriculture, which at first is introduced on trial, will thus become a fixed part of the school program of studies. This interest of the community will offer an excellent opportunity for the propagation of the more fundamental principles of farming among those farmers who have not had the opportunity to study them, or who have been too indifferent to heed the appeal for better

farming. (3) Right habits of procedure will be formed. Habits of doing certain things at given times are absolutely essential in successful farming. The habits of selecting seed corn in the autumn; of harvesting at the proper time; of storing grain properly; of grafting, mending tools, and doing other things that may be scheduled for the season of least activity; of cleanliness in milking; of testing the vitality of seeds; of starting early plants on time; of plowing when the season permits; of cultivating when the conditions require, — these are only a few of the habits that should be established in the life activities of every successful farmer. As the subject of habit-formation is coming to be regarded as of primary importance in education, it at once appears that the seasonal sequence of the study and teaching of agriculture partakes of a double importance.

CHAPTER VII

THE ORGANIZATION OF THE COURSE

THE problem of this chapter will be to organize the materials of secondary agricultural instruction in accordance with the principles established in the two preceding chapters. The seasonal determination will necessitate a sequence of materials in accordance with the seasons, and the psychological determination will necessitate a sequence in accordance with (1) the apperceptive factor, (2) the factor of innate dispositions, (3) the economic factor, and (4) the factor of acquired dispositions. Each of these determining elements is fundamental, and the procedure in secondary agricultural instruction must be in harmony with them. Of course all of these factors may not be operative at the same time nor with the same materials, but those that apply cannot be disregarded. This systematic arrangement in the sequence of the materials of instruction will constitute a course in secondary agriculture. These matters will be treated under five general heads.

1. Plant Studies

It was shown in the preceding chapter that, in accordance with the seasonal sequence, plants should be studied in the fall of the year, since this is the most appropriate time, while school is in session, when plants may be studied. Their fully developed condition may now be seen, and many of the successive steps in their development may be traced. An ideal may be formed from a comparison of many specimens as to what constitutes a perfect plant, or a perfect fruit, and the characteristics most to be desired in any given species of domestic plant may be learned. The formation of this ideal in the mind of the pupil in the beginning of his course, will greatly influence his future work in plant production, and will afford him a goal to be attained by his own efforts.

As before pointed out, the best time to begin plant studies from the standpoint of the economic factor in education is in the autumn, at the harvesting time, when the ripened fruits and grains may be utilized to furnish the basis of an economic approach. Fruits and grains appeal to the primitive interest of satisfying hunger. These are the

products that plants yield for feeding mankind. Out of the fibers produced by plants cloth is woven, which is used to clothe mankind. The first real interest of the human race in plant life must have been an economic one. The strongest interest that the individual has in growing crops is essentially economic. Plants should first be considered from the standpoint of food, clothing, and profit. Quantity and quality of production will naturally follow, and to secure these ends, the nature, habits, structure, development, care and cultivation of plants, diseases and their treatment, pests and their eradication, etc., will necessarily have to be considered. The opening of school in the fall of the year, at which time it is presumed that the course in secondary agriculture will begin, permits the study to take an excellent economic turn, and abundant opportunities are offered for first-hand observation of the final results of the year's growth.

Apperceptively considered, the beginning of agricultural instruction may be commenced with either plants or animals. We, therefore, also secure the added force of this psychological factor. In accordance with the principle of apperception, those fruits and

CORN JUDGING.

LEARNING THE ARTS OF GRAFTING AND PRUNING.

Methods of approach to plant studies.

grains, and the plants producing them, with which the pupils are best acquainted, should be first studied; these should be followed by the less familiar products and plants, and finally, the least familiar or strange ones should be studied.

Suppose, for example, that the class begins its plant studies with maize. This plant is chosen because no other domestic plant is so familiar to the average adolescent of this country. Ears of corn are seen on every hand throughout the year by the children of country and village. These objects at once arouse the interest of the pupils, and corn judging may at once begin. This study will naturally lead to a consideration of the characteristics of the individual plants that produce the best ears of corn, the conditions, cultivation, and the various circumstances involved in the production of a superior quality of this cereal. Similarly, wheat, oats, cotton, apples, pumpkins, etc., may be studied.

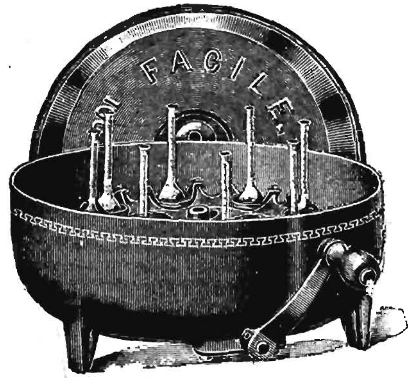
2. Animal Studies

As before suggested, at the beginning of the winter season when plant materials begin to wane, animal studies may be very profitably and conveniently begun. Animal products

may always be had at this time of the year, and an easy and interesting starting point will be afforded.

As with plant studies, so animal studies will begin with an economic approach. Butter, milk, eggs, wool, meat, etc., may be considered as articles of food, clothing, and profit. These things appeal very strongly to the primitive interests of the pupil, and afford an economic sanction for their study. There will again arise promptings to consider the conditions whereby the production of these articles may be increased and improved. The animals themselves will receive due consideration, and so, from point to point, as many phases of animal husbandry may be considered as may seem desirable and as time permits.

Of course, the apperceptive basis will require that the animal products, and the animals producing them, most familiar to the pupil, be first studied. Other farm animals may then be considered in accordance with the amount of knowledge which the average pupil possesses of them. The economic approach suggests that the product of each animal should always be studied first, to be followed by a study of the animal producing it; thus, in animal studies, the plan of pro-



A Six-bottle Hand Babcock Milk Tester Suitable for Use in the High School.

High School Boys testing Milk for Butter Fat.

An economic approach to animal studies.

cedure is similar to that used with plants. Milk offers an excellent and familiar object with which to begin the study of the cow, her care and feeding, the dairy type, butter, and, in a word, all about the elementary principles of dairying.

3. Machine Studies and General Farm Management

(*a*) **Machine Studies.**—The knowledge which children have of the common farm and garden implements and machines may well form the apperceptive basis for studying farm machinery. Such simple tools as the hoe, the rake, the spade, and the shears may be hastily reviewed, and the principles of each considered, and the proper way to use them demonstrated. The pupil who has developed habits in the use of these tools will doubtless experience a pleasurable reaction in this last exercise, if not pushed to the extreme of monotony or fatigue.

The propensity gained from the habits acquired in the use of the various garden tools and the operation of the simpler machines of the garden and farm should be understood by the teacher and a pedagogical use made of it whenever possible. A lever may be pulled just for the gratification gained in satis-

fying the propensity of an automatism previously acquired in the operation of the machine. When such propensities are manifested by the pupil there will be interests present, and the teacher should be on the watch for them. If a lever is automatically operated, it will be very easy to interest the operator in the reasons for securing certain results by such operation. The construction, the adjustment, and the relations of the various parts of the machine concerned in the lever action should be studied, and from these attention should be directed to other parts of the machine.

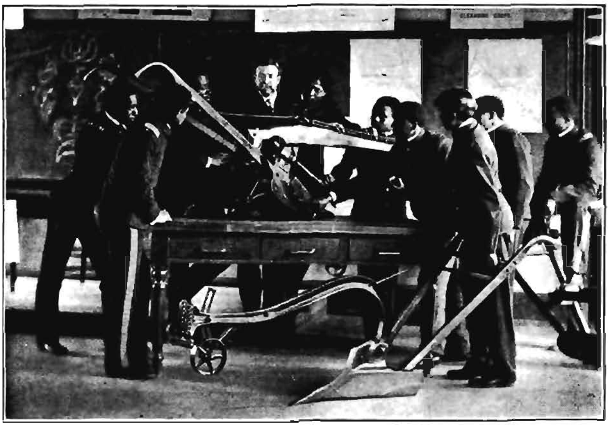
After a machine, such as the mowing machine, has been carefully studied, it would be proper to allow the pupils to take the machine apart and then set it up again. This will be gladly undertaken by normal boys, since a direct appeal is made to the constructive instinct.

The economic factor may be employed to advantage, especially in communities where farmers are in the habit of allowing their machinery to remain out-of-doors, exposed to the weather throughout or during a part of the year. The damage thus caused, and the consequent loss, will emphatically em-

(*Photo. by B. E. Mowrer.*)

STUDYING THE GASOLINE ENGINE.

Minnesota School of Agriculture.



STUDYING THE PLOW AT THE HAMPTON NORMAL AND AGRICULTURAL INSTITUTE, HAMPTON, VIRGINIA.

Machine studies.

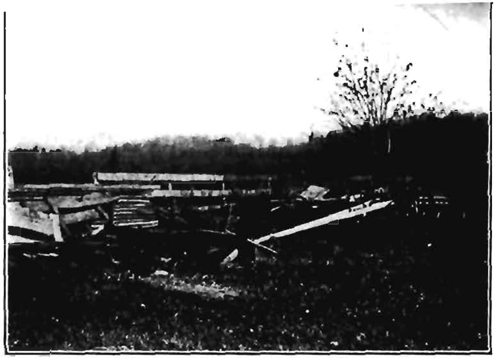
phasize the necessity of keeping farm machinery well housed at all times when not in use. That season of the year when there is the least activity in strictly agricultural pursuits affords an excellent time for the study of farm machinery. Sometime during the winter months all the machines and implements of the farm should be examined, oiled to prevent rust, and the weak and broken parts placed in good repair.

(*b*) **Farm Management.** — Most families appreciate the necessity of good management as a condition of success. High school pupils will readily understand that good farm management must go hand in hand with the application of scientific principles of cultivation. Many of them will know instances of failure or of mediocre prosperity attributable to poor management. Wastes on the average farm may easily be pointed out, and the procedure in the management of the farm in order to avoid them should be discussed. The matter will thus come to have an economic appeal. The interest thus engendered may very easily be led to expand beyond the rim of the "almighty dollar." The desire to meet the conditions for the greatest financial success should result in the securing of cleanliness

about the farm, the use of all sources of fertilizers, the destruction of weeds; and these things should awaken an interest in other matters, as the keeping of things in order about the place, the prompt repairing of fences and buildings, and even landscape gardening for the beautifying of the home grounds.

The latter weeks of the winter season is also an excellent time to make studies in general farm management. This is the time of the year when the farmer should plan his farm operations for the ensuing year; new plans of the farm should now be instituted, the plans for the rotation of crops for the various fields determined and recorded, plots drawn of orchards, gardens, and yards; buildings, and fences planned; the work of the year should be reviewed and all failures noted, and the cause or causes of such failures studied with the view of avoiding them in the future; special problems should be solved, and agricultural literature should be studied on the subject; and finally, a balance should be struck in order to determine the proceeds of the year's labors.

This last item suggests the advisability of knowing something about farm accounts and



Rust.

Rot.

Waste.

Want.

Some examples of poor farm management.

the application of mathematics to the farm activities. There must be a degree of accuracy in measurements — even in farming. If everything we require could be had for the asking, there would be no need for the careful measuring of quantity. But at no stage in the history of the human family do we find such to be the case. The necessities of life are all limited and can only be had through activity. This calls for energy, and since our energy is limited, measuring is required, if we would not dissipate it.

4. Soil Studies

Man's attention was directed to the consideration of the soil when it began to fail in productiveness. When, after long periods of cultivation, large areas of land became visibly less fertile, and plants were raised with much greater difficulty upon these areas than upon new ones, man began to recognize that a vital relation exists between the soil and the vegetable life which grows in it. It must have been early noticed that manure, and other decaying materials, increase the productiveness of the soil and that careful cultivation will hasten the growth of the plants and conserve the moisture. Each race

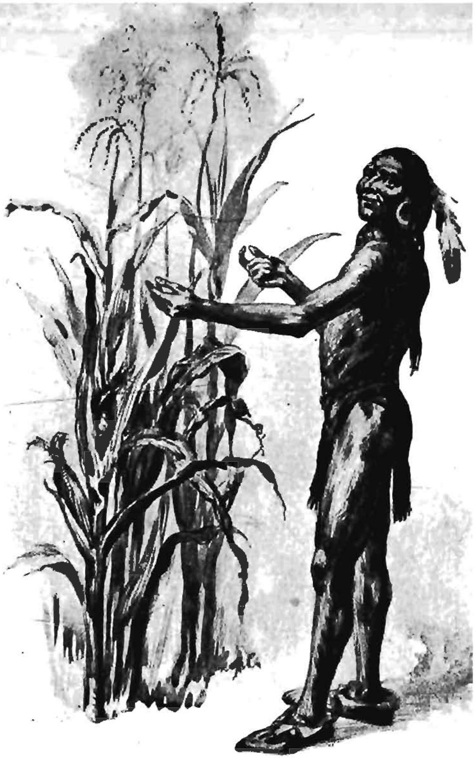
has had its Squantos and its Tulls, who gave to mankind a new vision. It was a long time, however, before the real causes of the loss of fertility of the soil were discovered, although many of the conditions by which this fertility may be renewed and maintained were known many centuries ago. Soil fertility and the proper management of the soil continue to be of vital interest to every progressive farmer to this day. The incentive for this lively interest is an economic one, and this, together with curiosity to learn reasons, should furnish the basis for securing the interest and the desire of the high school pupil for the study of this topic.

The study of soils may well begin with simple soil-fertility tests in the high school greenhouse,[1] with which every high school that pretends to teach agriculture should be equipped. The progress of this test will raise the questions of the sources of soil fertility and its maintenance, the different types of soils and their physical properties, the relation of water, heat, and air to soil, and many

[1] Grannis, F. C.: "The High School Greenhouse." The Illinois Agriculturist, Vol. XIV., pp. 23–24. College of Agriculture, University of Illinois, Urbana, Illinois.

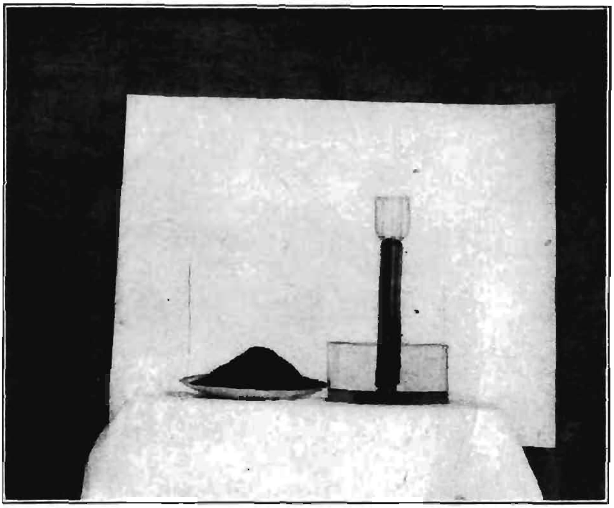
(Courtesy German Kali Works, New York City.)

PLANTING THE FISH WITH THE SEED CORN.

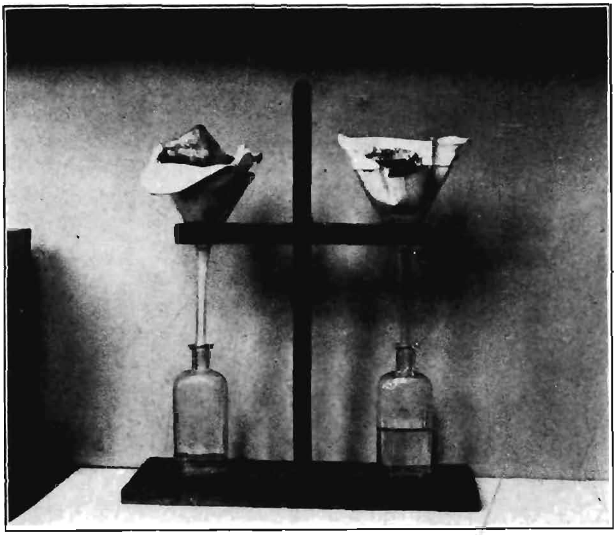


HOW WELL THE CORN PROSPERED!

Squanto teaching his lesson.



THE RISE OF WATER IN SOILS BY CAPILLARITY.



THE RELATIVE POWER OF DIFFERENT SOILS TO RETAIN WATER.

Soil studies.

other interesting and important questions connected with soil studies.

As before suggested, this work may be satisfactorily done in the laboratory during the latter part of the winter season. A good supply of the different types of soils should be stored away in the fall for use at this time.

The question of the care and use of manure may also be considered in this connection. The waste on the average farm resulting from carelessness and ignorance in this respect should be observed, and the proper methods of caring for manure should be studied and illustrated. The effect of manure upon the soil may be illustrated in the laboratory and the greenhouse. Samples of commercial fertilizers should be collected, and the elements composing them should be noted.

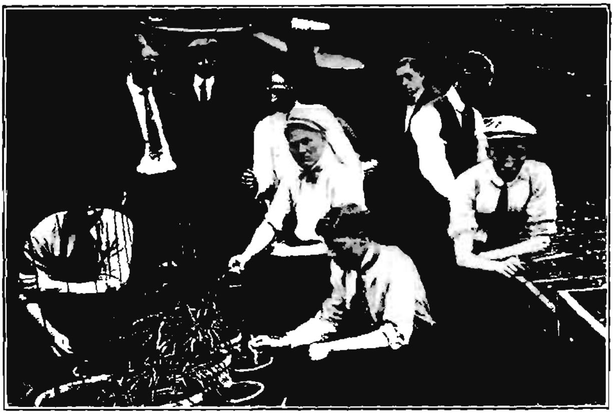
5. Conditions of Plant Growth

Under this head we have a combination and application of many of the principles that have been previously learned concerning plants and soils. The intimate relation that exists between plants and soils, moisture, temperature, light, fertility, and cultivation cannot be ignored, and naturally and logically

should come at the end of a course in agriculture. From the appreciative standpoint, it is plain that the pupil should have clear ideas about plants and soils and their many aspects before he begins the study of the relations that exist between them. It is in the spring of the year that this relation between the plant and its environment, including the soil, is most apparent.

(*a*) **The Greenhouse.** — The first studies in plant ecology may be made in the greenhouse. The effect of drainage upon soils and plant growth, the regulation of moisture conditions by the use of manure and mulch, the effect of cultivation on moisture conditions, the temperature conditions on plant growth, germination tests and the most favorable conditions for the germination of various seeds, potting and resetting plants, the use of liquid manure, inoculation demonstrations, propagation of cuttings, the starting of early plants, and plant breeding are some of the activities that may be carried on to advantage in the high school greenhouse during the months of February, March, and April. The construction and the use of hotbeds and coldframes may be studied, and practice given in these activities.

A GREENHOUSE BUILT BY A HIGH SCHOOL BOY.



INTERIOR VIEW OF THE SECONDARY SCHOOL GREENHOUSE, UNIVERSITY OF ILLINOIS, 1909–10.

The high school greenhouse.

A PORTION OF THE DEMONSTRATION GARDEN IN CONNECTION WITH THE DEPARTMENT OF ELEMENTARY SCIENCE, STATE NORMAL COLLEGE, OHIO UNIVERSITY, ATHENS, OHIO.

A MEMBER OF THE AGRICULTURAL CLASS MAKING A REPORT.

Every effort should be made to place the greenhouse, hotbed, and coldframe on a paying business basis, and the funds so realized should be applied to the maintenance of the greenhouse; to its care, which should be intrusted to one or two earnest pupils with a fair remuneration for work outside of class practice; and to additions and improvements. Little trouble will be experienced in disposing of the greenhouse crops of early *tomato*, cabbage, and other plants for the garden. Geraniums and carnations, etc., grown from cuttings should also find a ready sale. The class will readily discover other sources of profit, which they should be encouraged to realize so long as the work planned for the course is not hindered. Thus will interest be increased and the principles involved will be made more vital.

(*b*) **Field Operations.** — When spring opens up so that planting may be safely begun in the open, garden and field operations should be commenced. Rotation plots, fertilizer plots, and such other garden and field demonstrations, practice, and studies as the class is able to execute should be started and carried forward. An effort should be made to place this work upon a paying basis. If this is

done, not only an economic appeal is furnished, but an excellent opportunity is given for teaching methods of keeping farm accounts, and actual training in the same may be had.

It should be remembered that it is not the object of the high school to produce professional agriculturists, but to teach the elementary scientific principles involved in agriculture as a part of general culture. It is no more the duty of the high school to produce professional agriculturists than it is to produce business men, lawyers, physicians, or teachers. Pupils should be given enough practice in the application of agricultural principles to enable them to use such principles should they elect farming for a life work. If these pupils become farmers, they will then be enabled to give their entire time and attention to the work of farming; for the present, however, they are being educated.

The pupils will enjoy the practical work until they have learned how to do it; but after this point has been reached, there will be danger of carrying some of the exercises to the extreme of monotony or fatigue. Care must also be taken not to infringe upon

the time of the pupil that should be devoted to other courses of the school. Class work is necessarily regular and limited, and the extra attention demanded by the growing crops should be arranged for from another source than that secured from the pupils during the class periods. As in the case of the greenhouse activities, provision should be made to have the work of cultivation and tending for the most part done by some responsible person or persons. Often members of a class may be induced to take the extra care of a section of a garden for the produce that it will yield.

The great and ultimate object of raising the usual farm crops is to feed, clothe, and shelter man or beast. It is an economic aim, and involves the production of the greatest amount of superior plants, with the least diminution in the fertility of the soil. The desire of the pupils to raise fine specimens of plants in large quantities can easily be appealed to. The necessity for applying the best methods of agriculture, which involve scientific principles, becomes imperative. The necessity of preventing any unnecessary deterioration of the soil becomes at once evident, and the young agriculturist should be

made to realize that it is the duty of the present generation to relinquish to the next an unimpoverished soil. Thus shall he not live for the present alone, but for the unknown ages yet to come.

In such an organization of agriculture for the secondary school, we have the economic approach, the economic sanction, and applied science — all of which are so necessary to the most efficient development of the adolescent.[1] Man's interest in agriculture began with the things which he most needed. So in each division of the subject given above, he first developed interest in those things which were of the greatest and immediate service to him in the satisfaction of his primitive needs. More directly than any other industry, agriculture supplies mankind with the articles that satisfy his primitive needs. These things require, in the child, an apperception of low degree.[2] Primitive needs, such as are re-

[1] See the experiment of J. P. Gilbert with pure and applied science methods of approach in secondary school science. The Journal of Educational Psychology, Vol. I., pp. 321–330.

[2] See Bagley's "The Educative Process," pp. 94–95, where apperception of low and high degree is fully and clearly discussed.

quired to satisfy hunger and protect one from the elements, are capable of awakening the interest of the child and the young adolescent most easily.[1] The economic approach and sanction appeal to a very strong instinct in the child.

But secondary agricultural education must not stop here; it must advance to things that require apperceptions of a high degree. Agriculture is no longer primitively apperceived as merely a means to satisfy primitive wants.[2] We also attach a higher significance to it, *e.g.*, ornamental gardening, and floriculture, which have for their aims the satisfying of the æsthetic appreciation of mankind; or the preservation of the fertility of the land, which anticipates the husbanding of the wealth and the power of the nation, and the amelioration of the conditions of life of future generations of mankind; or the recognition of an omnipotent Power that animates all life and that lies at the very genesis of natural production. Not primitive interests, but secondary ones need to be awakened in the life of the youth. These are the ones that fire

[1] Dopp's "The Place of Industries in Elementary Education," p. 112.

[2] Bagley's "The Educative Process," pp. 84–85.

his ambitions, electrify his energy, and clarify his vision of life. From the study of the materials in the order indicated, deductions and generalizations may be made and formulated; then the right application of science to the art of food production becomes clear and possible. The relation of education to life becomes apparent, and the ensuing result is enhanced power of service, together with a desire to be truly serviceable. The knowledge thus gained will be practical; it will also be cultural. The economic approach will result in the acquirement of as much or more knowledge of the subject than would result from a pure science approach,[1] besides the former will leave the added power of ability to use.

In familiar pedagogical language, then, proceed from the things that are most familiar to those things not so well known, and then to the strange in the pupil's experience; from concrete examples to abstract principles; from economic considerations to truth for its own sake; from the primitive needs and interests to secondary interests and ambitions; from

[1] See Gilbert, J. P.: "An Experiment on Methods of Teaching Zoölogy." The Journal of Educational Psychology, Vol. I., pp. 321–330.

the real to the ideal. The immediate, economic, realistic incentive is used as a motive force by means of which the individual is impelled onward and upward and finally attains an ideal, which quickens his realism into active, altruistic service.

CHAPTER VIII

AIMS AND METHODS OF PRESENTATION

THE ultimate aim of the use of agricultural materials in education is the development of the individual so that he may yield to society the very best service of which he is capable. In order that this high aim may be realized, there are several elements that need to be acquired by the individual in the course of his training. These various elements which the youth must acquire, with the best methods for securing them, will now be discussed.

1. INFORMATION

The first necessary element for the youth to acquire is information about the world in which he lives. The activities of man are limited and conditioned by the forces and the laws of nature. Other things equal, the greater the amount of information that an individual possesses, the more intelligent will be his activities. The acquiring of information and

its elaboration into serviceable forms by means of thought processes are the first achievements in the process of education. The devices employed for the purpose of transmitting information to the pupil are various, and depend largely upon the nature of the information to be taught.

As before stated, agriculture is both a science and an art; it deals with both a body of organized laws and principles, and with their application to the actual problems of producing the raw materials for food, raiment, and shelter. Both learning and doing are involved. The art of agriculture requires incessant contact with natural, material things, and it is upon these same objects that the science of agriculture is based. Our methods of instruction must, therefore, take cognizance of them.

It is because of this material basis of agriculture — and the same is true of the other physical sciences — that instruction by word of mouth and by means of books is not so effective as in teaching the humanistic subjects. The function of the book is to express in terms of printed language the information which a mind has acquired by contact with the original object itself, and to transmit that

information to other minds. It must, however, not be overlooked that the correct reception of the information concerning material objects thus transmitted is conditioned upon the experience of the would-be learner. If the learner has not had or cannot have sense experience with the particular object that is being talked about, or that is being read about, he can get no true conception of the meaning, and, therefore, his information will be imperfect. The mind of the learner must be brought into direct contact with the real thing. It is not sufficient for the pupil to be told a thing; he must be made to experience it. He must be brought to understand that the particular thing is precisely as described. His reactions must at least include those anticipated by the process of instruction. First-hand knowledge is essential in the informational teaching of the physical subjects, and especially is this true of agriculture.

But it is not to be understood that the pupil must get all his scientific facts from his own studies in the laboratory, greenhouse, garden, or field. To advocate this would be absurd. Such a limitation as this would make it impossible for the average high school pupil to

acquire anything like a general view of the science within the limited space of time that may be devoted to it. The pupil should gain a working basis of fundamental typical facts, and, upon this original knowledge as a foundation, facts and ideas may be acquired from other sources through the media of art and language.[1] Many generalizations must be given to pupils on a limited number of experiences on their part. It is a serious mistake, scientifically as well as pedagogically, to lead pupils to think that the result of one or two experiments performed under the ordinary conditions of the high school laboratory, greenhouse, garden, or field may be regarded as conclusive proof of a great principle or law, or even as a true index of natural conditions. Too many farmers to-day make this very mistake and think that one or two trials are conclusive proof. The indigo plant might never have been introduced into the colony of South Carolina had it not been for the repeated experiments of a woman. Let us be frank: the experiments performed by high school pupils are intended to show the

[1] Lloyd and Bigelow's "The Teaching of Biology in the Secondary School," p. 297. Longmans, New York, 1904.

line of thought by which the proof is obtained — they do not necessarily give it.[1] Research methods are not the best ones to use in this work; they must be greatly modified when used.[2] The answers to the problems of the high school pupil are known, the great discoveries to be taught him have been made, and the laws and principles formulated; our problem is to teach these to the pupil so that he may learn them and develop the ability to apply them to the affairs of life.

There was a time when science was taught from books, at least it was attempted; then we swung to the other extreme and tried to teach everything first hand, by means of methods that involved very minute observations by the inexperienced pupil in a poorly equipped laboratory. We are now beginning to see that, with high school pupils at least, we must select and combine the best that there is in these two methods, and allow the teacher to aid the pupil in the proper interpretation of scientific data. "The laboratory method is a good method, so far as it goes.

[1] See Jesse E. Whitsit in Science, Vol. XXXI., p. 977.

[2] De Garmo, Charles: "Principles of Secondary Education," Vol. 2, pp. 68–69, 70. Macmillan, New York, 1908.

For most pupils it is essential to a firm understanding, a clear vision, a just perspective. Experience of the senses is the solid ground from which the highest flights of speculation and theory in science begin, and to which they must return, with or without safety to the voyager. But learning by experience is a plodding method, and the student who aspires to any great height or breadth in intellectual reach must not confine himself to it."[1]

In the teaching of agriculture, therefore, there must be opportunity for constant reference to the natural objects and phenomena concerning which information is sought and given. A properly organized course in secondary agriculture must be primarily and fundamentally a series of laboratory and field exercises made up of carefully selected materials, pedagogically and systematically arranged, around which recitations, lectures, and reading will center as supplementary work. We are always compelled to get back to nature for our proofs, yet the interpretation of scientific data must always remain a process of logical thinking.

[1] Smith, Alexander, and Hall, E. H.: "The Teaching of Chemistry and Physics," p. 305. Longmans, New York, 1908.

2. Ability to Do

The individual characteristic of power to do is the true criterion of culture. "By their fruits ye shall know them." Development of mind is not sufficient; we have too many "top-heavy" people. Knowledge secures its full fruition when it is used by its possessor as an instrument for the securing of comfort and happiness to mankind. The reaction of skill makes for culture in a true education.

American industrial education is an education for efficiency and service. Knowledge becomes power only when it is capable of application to some phase of life. Industrial education stands for just these things — knowledge and consequent skill in its application. "Any scheme of teaching which does not set forth the process of learning as applied, not only to general notions, but to complex individual notions; not only to knowledge or science, but to the practical ability to use it, — any scheme which does not show not only how certain things are done, but how to do them with facility, accuracy, and efficiency in general; . . . — all such schemes are seriously at fault."[1] "Knowl-

[1] Rowe: "Habit-Formation," p. 29.

edge for its own sake, from this standpoint, is a dangerous superstition, for what frees the mind is disastrous if it does not give self-control; better ignorance than knowledge that does not develop a motor side."[1] Not until there is acquired the ability to do is the educative process completed. The present conception of the doctrine of formal discipline requires that the specific application of a general principle be not left to chance. Not until then is there consciousness of real power.

One of the crying needs of our time is for young men with the ability to do — to take the initiative in great undertakings, to apply knowledge to the active affairs of life, and to bring about practical and serviceable results. It is well known that unless this characteristic is acquired by individuals before the age of adolescence is entirely past, the world will never, except in rare cases, secure any marked service from them.[2]

A course in secondary agriculture should make ample provision for applying the knowledge acquired. The art of agriculture may be mastered in no other way, and a course in

[1] Hall's "Adolescence," Vol. I., p. 204.

[2] See Chapter III. of Joseph Alfred Conwell's "Manhood's Morning." Vir Pub. Co., Philadelphia, 1903.

agriculture that does not make provisions for this is not worthy of the name. The practical work of the laboratory, the greenhouse, the garden, and the field will be fundamental requirements and should constitute no small part of the secondary course. The practical, economic use to which such a training may be put is at once recognized, and the educational value has been pointed out.

3. Good Habits

Habits are the crystallizations of our mental and physical experiences. By means of them an individual is enabled "to hold fast that which is good" in his life experience; and for the same reason many things that are not good cling to him. The problem of parents and teachers is to secure the development of good habits in children — automatisms that shall function so as to secure desirable and serviceable adjustments of the individual to his social and physical environments.

Habits are built up through information and repetition of motor expression. A youth may have the information, and he may possess the practical ability to do, but the possession of these elements does not always give assurance that when the opportunity offers, these

WHERE THEORY BECOMES THE HANDMAID OF PRACTICE.
Acquiring the ability to do.

WHERE THEORY AND PRACTICE MEET.
(Observe the cloth cover over the milk pail.)

things will flow out to some practical purpose. One thing more is needed; the information and the ability to do must be built up into automatisms so that when the individual comes into a certain environment, or when certain conditions confront him, he may effectively coördinate fundamental adjustments that in themselves are already on the plane of habit. Thus is the proper utilization of information and ability to do assured. This is not only a preventive of wrong action, but a cure for inaction. Good habits and laziness are strangers, and the same may be said of the relation of good habits and sin in all its forms.

To secure a habit there must be conscious drill of the activity to be rendered automatic. Ability to do, which is attained by practice, does not necessarily imply a habit. The formation of a habit involves more drill than the attainment of conscious ability to do. The law of habit-formation may be stated thus: "*Focalization of consciousness upon the process to be automatized, plus attentive repetition of this process, permitting no exceptions until automatism results.*" [1]

The course in secondary agriculture should be so planned and executed that many and

[1] Bagley, "Classroom Management," p. 16.

serviceable habits shall be acquired by the youth, not only with regard to the relations of the individual to farm environments, but with regard to the anticipated relations of the individual to nature and natural phenemona wherever found, as well as to his social environment. The automatisms required in carving a turkey at a social dinner may be as essential to the young man as are those needed in manipulating the plow.

One of the periods of life most susceptible to the process of habit-formation is that of early adolescence. It is the revolutionary period in the individual life. High school courses should make more of this great opportunity for habit-formation than they do. The course in secondary agriculture properly taught may here do a great service. The many automatisms that may and should be taught in agriculture will necessitate laboratory, garden, and field equipments.

The foregoing three elements of acquisition — information, ability to do, and good habits — are the primary ones in the educational program that leads to efficient service. They are those that are most intimately concerned with the immediate and the practical. They

represent the primary elements of an education; they are the elements of the machine, which must be controlled and directed by the secondary elements of high ideals, and right points of view.

There is still need for the secondary elements, before truly efficient service may be secured. It is to these more general characteristics, to the higher and the more ideal aims in the education for service that we shall now turn. It is just as essential that the secondary elements be acquired as the elementary; if it is fundamentally necessary that the one come first, it is also as necessary that the other come after; without the elementary there can be no secondary, and without the secondary, there can be no complete education for real efficiency.

4. Right Points of View

When the information of the science, the ability to do, and the automatisms of the art of agriculture have been gained, there should be a review of the facts and processes to secure right points of view. There need to be organizations of materials, classifications of facts, groupings of principles, and interpretations of laws.

In the recitations devoted to reviews, the pupils should be encouraged to express their individual findings and opinions. This will lead to the perception of the facts, the principles, and the laws — or their applications — from different standpoints. The universality of truth will thus come to be respected. There will be developed broadmindedness in that each pupil will learn that the ideas of others are quite as sound and important as his own.

Through the mass of scientific data and facts needs to be drawn the silver thread of induction. The relative importance of the individual facts is thus revealed, and the many seemingly disconnected facts are seen to be related to the general law. The reasons for definite procedure and special applications are understood, and farming comes to be a matter of intelligence rather than of imitation.

The point of view may best be secured by the recitation. The scientific matter is now well in hand; the information is understood. When the instructor speaks, his pupils know what he is talking about. When he interprets a law, they feel the significance of it. When a fellow member of the class reports a specific instance that illustrates a general

principle, the remaining pupils see its bearing on the whole.

The same is true in regard to the reading of the pupils. The mass of agricultural literature, wherein are reported the findings of others, may be understood and weighed from the point of view which their training has yielded to them. The views and the findings of others will receive a sympathetic consideration, and the way will be prepared to give them fair trial.

Farming has sometimes been regarded as a calling unworthy of the highest ambitions of young men and young women, and the best boys and girls of the farm have too often spurned opportunities for securing independence, a small estate, a home, and the blessings of country life because they imagined that the calling of the farmer is not worthy of them. But a different opinion is being formed in the minds of the rising generation concerning modern agriculture. Young men and women are to-day pursuing courses in agriculture and domestic science in our high schools and colleges with the definite purpose of returning to the farm and there following the calling of their fathers and mothers, and contributing their mite in producing " bushels

of happiness" for the nurture and the pleasure of their fellow men. Nor will all the pleasure be that of others; no other station in life is so filled with happiness, health, and wealth as that of the American farmer.

5. High Ideals

The inert materials of science must be infused with a soul before they can have life. They must be animated by an ideal to dispel the ennui that often attends their minute, careful, and patient study. Again, if the lessons of science are to wield a directive influence in the life of the youth, they must be epitomized into dynamic ideals closely related to life and action.

The ideal of work as the only effective means of accomplishing results of consequence on the farm, as well as in other walks of life, needs to be inculcated, and the practical work of agricultural training is designed to develop this ideal. "The end of life can never be adequately formulated in terms of comfort and ease, nor even in terms of culture and intellectual enjoyment; the end of life is achievement, and no matter how far we go, achievement is possible only to those who are willing to pay the price. When the race

stops investing its capital of experience in further achievement, when it settles down to take life easy, it will not take it very long to eat up its capital and revert to the plane of the brute."[1]

In his science work the pupil will have learned the necessity of accurate observation of natural objects and phenomena, and the importance of this activity of the mind will have thoroughly impressed itself upon him. He will have learned how to use this activity in the observation of things agricultural; and the ideal that he should form, and which he ought constantly to follow in the exercise of this activity, will aid him to use it in other fields of life that are not necessarily agricultural.[2] If this transfer of formal discipline be possible, then it matters little whether the power and habit of observation was acquired in the study of agriculture or some other science; but in the study of agriculture, the pupil has the superior advantage of seeing the special uses that Nature makes of her general laws, perhaps to a greater and wider extent than

[1] W. C. Bagley on "Education and Utility." The Normal School Bulletin, October, 1909. Eastern Illinois Normal School, Charleston, Illinois.

[2] Cf. Bagley's "Educative Process," p. 216.

would be possible in any other study; consequently, the worth of observation is likely to be more thoroughly appreciated — observation may become the ideal method of securing valid information.

Similarly, other ideals of accuracy, order, persistence, investigation, etc., may be inculcated from the sheer necessities that arise from the emergencies of applying the principles of agriculture. A boy cannot hope to make a successful graft unless he uses the utmost care in observing the details given in the directions for the practice exercise; neglect to spray at the proper time may cost him the loss of a whole or a partial crop of fruit. Likewise, the girl who is inaccurate and careless in measuring the ingredients of a recipe may spoil the pudding, or, if she does not follow the pattern, the cloth may be ruined.

The force of the ideals in one's life aids in the attainment of more rational living. If the ideal be strong enough, it will govern all our acts from day to day. Its emotional prejudice will keep us true to ourselves. Ideals are the silken threads of consistency upon which the golden acts of our lives are strung.

CHAPTER IX

THE ORGANIZATION OF THE LABORATORY AND FIELD WORK

It is very evident, from the preceding discussion, that the laboratory and field work of secondary agriculture should be something more than a mere performance of a given number of exercises at stated periods. The laboratory and field work becomes the very basis of agricultural study and teaching, and as such it should be carefully organized in accordance with the psychological and the seasonal determinations of the sequence of materials and activities which are established in Chapters V. and VI., and the methods of presentation should be based upon the principles derived from the considerations of the foregoing chapter.

From the standpoint of the seasonal requirement, the exercises should be so selected as to conform as nearly as possible to the various seasons of the year. If this is done, there will always be an abundance of ma-

terials available for the use of the class. This requirement will be readily met if the various exercises are taken up in accordance with the organization of the course, as presented in Chapter VII. The exercises should be classified into five groups, each group corresponding to one of the five general heads of Chapter VII.

The best mental development of the pupil may be secured by organizing the agricultural materials of instruction in conformity with the psychological requirements as discussed in Chapter V. Under the various groups of exercises into which the instructional materials of secondary agriculture may be classified, simple exercises *should come first and should deal* with objects that are familiar to the pupil; they should appeal to one or more of the instinctive factors; their practical use or value should be quite evident so as to secure the economic sanction of the pupil; and they should, if possible, appeal to the motor propensity of his automatisms. From these primary requirements, the exercises may gradually become more complex; they may increasingly appeal to the higher secondary interests of life; and the narrow and selfish appeal to the individual must be replaced by altruistic ideals and the desire of service for others.

1. Classification of Laboratory Exercises

The laboratory and field exercises of secondary agriculture should not all be cast in the same mold, but should be considered with respect to the end in view. There are four general aims to be attained by the laboratory and field work of secondary agriculture: the *discovery* of new truth by the pupil; the *demonstration*, by the instructor, of facts which it is desirable the pupil shall learn; the *verification* of facts which the pupil already knows, for the purpose of clarifying and intensifying his knowledge; and *practice* in the practical application of his knowledge, by means of which he shall receive motor training.

Discovery. — The exercises by which the student discovers new truth may be designated by the word "experiment." In performing an experiment, the student assumes the rôle of an investigator. He is to experiment with the object of discovering new truth, — a new principle, *i.e.*, new so far as the pupil is concerned. As the investigator has a fairly clear idea of the thing that he desires to accomplish, and a knowledge of the various related facts and the relation these probably hold to the new thing to be discovered, so the pupil, in performing an experi-

ment, should first have clearly in mind the object of the experiment, the reasons for performing it in a given way, the probable relation of facts which he already knows to the new one under investigation, and a knowledge of the probable causes of error. It is evident that such work is of a very advanced nature and should be attempted only after the fundamentals of the subject have been gained and a good degree of skill in laboratory methods has been acquired. These experiments of discovery should, therefore, be placed well toward the end of each group of exercises. So far as possible, they should be individual, and never more than two pupils should be permitted to work together.

Suppose, for example, that an investigation were to be made of the effect of a surface mulch upon the conservation or dissipation of moisture. The pupil should understand that the purpose of the experiment is to ascertain what effect a surface mulch will have upon the moisture of a given amount of soil; he should know something about evaporation and capillarity and the probable relation of these facts to the loss and the supply of moisture to the surface soil; he should understand why it is necessary to make two tests —

one with a mulch and the other without; and the possible sources of error should be understood by him. (See Exercise No. 7, p. 176.)

Verification. — The exercises by means of which the pupil confirms the statement of a fact or principle which he has read or heard may be called verifications. Both the object of the exercise and the result to be expected are known by the pupil. He satisfies himself that the statement of a certain principle or law is true. So far as possible, verification exercises should be worked out by individual pupils, and not more than two should ever work on the same one. Before beginning such an exercise, the pupil should be thoroughly informed regarding its nature, the method of procedure, and the principle or law which it illustrates.

It is by means of this kind of exercise that the pupil acquires skill in the use of laboratory apparatus and receives valuable training in laboratory and scientific methods. Abstract ideas are thus objectified, the proper relation of facts perceived, and natural phenomena come to be correctly interpreted. The pupil's own knowledge will be clarified, and his power of grasping and retaining truth will be enhanced.

The pupil may have read or heard, or his teacher may tell him, that the peel of a potato prevents the loss of the water that the tuber contains. It would not be advisable to use the exercise by means of which this fact is proved as a demonstration, since the time required for its completion would be too long. The better plan would be to have the pupil verify the statement by means of the directions given in Exercise No. 2, p. 168.

Demonstration. — The purpose of the demonstration is to teach a certain principle or fact to the class by means of a combination of materials and conditions manipulated and controlled by the teacher. It is an inductive method of teaching. The teacher, but not the learner, is supposed to have foreknowledge of the result. Each step in the demonstration should be carefully interpreted, either through explanations by the teacher or through answers to well-selected questions, asked by him. The class should be directed when and how to make observations. Each demonstration should be followed by searching questions on the part of the teacher and concise and definite answers on the part of the pupils. Conclusions should be drawn or laws stated at the end. The exercises

should never be concluded until the aim striven for is fully realized. The demonstration thus becomes the basis of inductive instruction, which should be further supplemented by reading in various books, bulletins, and papers. As a rule, demonstration exercises should be short, so that they may be completed in one recitation period.

Suppose the lesson is concerned with the reason for storing seed in dry places above freezing temperature over winter. The first step will be to call the pupil's attention to the fact that it is only the moisture in the seed that freezes, and not the substance of the grain. His experience will readily lead him to perceive this. The next step will be to show him that there is moisture in the grain. This may be, perhaps, most efficiently done by means of a demonstration. (See Exercise No. 1, p. 167.)

The fact that there is moisture in seemingly dry seeds may be quite as well taught by means of an experiment, or a verification, as by means of a demonstration. The advantage of the latter exercise over the former two is the brevity of time required thoroughly to teach the fact desired. The experiment by its very nature requires much time, and it

is not always desirable to have the pupil verify each fact or principle to be learned. The performance of the demonstration by the instructor will furnish the pupils with examples of procedure and many useful hints, which they may imitate in performing their own verifications and experiments.

Practice. — The aim of practice work is to enable the pupil to acquire skill in the practical application of his knowledge. It is also a means of expression. Most pupils know more than they can do. In agriculture it is not enough for the pupil merely to learn a principle; he must be able to apply it. He must not merely know how a process is performed, but be able to perform it himself. By doing, he receives training, and the reaction from doing successfully gives him consciousness of power By doing, the pupil may also learn many details that he had previously overlooked.

If the exercise is to be practice work in the laboratory, greenhouse, garden, or field, the particular thing to be done should, in most instances, first be explained and performed by the teacher as an example. The greatest difficulties should be pointed out and directions given how best to master them. The

teacher thus helps the pupil to develop the idea of the habit, which is the first phase in habit getting.[1] The pupil should then be given opportunity in the practice of securing the particular adjustment, or adjustments, in question. The pupil will at first proceed by imitation, and to be successful in this, he should be directed to give his attention to the particular activity that he is trying successfully to execute. From this focalization of consciousness and drill, he will develop a permanent adjustment to the environment given him, and the result will be a habit.[2] Exercises of this nature may be designated by the term "practicum."

Suppose the instructor desires to give his class practice in "tongue grafting" (Exercise No. 4, p. 171). He should first demonstrate to his class how to make a tongue graft, by calling attention to the common diameter of cion and stock at the point of contact, the way to cut the notches, how to fit together the cut surfaces, and how to wrap the binding material. Then each pupil should be allowed to make several specimens of this

[1] Rowe: "Habit-Formation," p. 87.

[2] Cf. Bagley's "The Educative Process," pp. 122–123, 241–242, 243.

graft, each of which should be submitted to the instructor for criticism. The exercise should be continued until the pupils have mastered the art of tongue grafting.

Each of these classes of laboratory exercises has its own peculiar educational value. From the demonstration, the pupil secures the correct idea of the matter under discussion and its correct interpretation; from the verification, he receives clarified knowledge and training; from the experiment, he develops respect and sanction for the scientific method of investigation and thought; and from the practicum, he derives that modification of his individuality through which a new adjustment to his environment is gained.

A series of laboratory exercises arranged in accordance with the principles previously set forth, around which the recitation, the lecture, and the reading should center, would form an effective course in secondary agriculture. Such a series of exercises would have to be made up largely of carefully selected types.[1] These type exercises would furnish the means of forming habits that the

[1] De Garmo, Charles: "Principles of Secondary Education," II., p. 71. Macmillan, New York, 1908.

stimuli of farm life would tend to set into operation. The types should have an element of commonness with the future conditions that the pupil will likely meet. This common element in the situation of the farm life and the past school training will suggest the use of certain habits previously learned at school; hence, the use of types for developing skill. It is the element of commonness that gives the cue, and forms a sort of apperceptive basis for the functioning of habit. There is at present great need for such a systematized series of exercises for the laboratory and field work of secondary agriculture.

In the fall of 1909 the following *questionnaire* was sent out: "What principles of agriculture do you suggest that each class of students should work out in the high school laboratory?" These were sent to both college and secondary school men who have had experience in teaching agriculture. Following is the summary of the eighty-six answers received.

Total number of subjects given	229
Number of subjects in general plant studies . .	73
Number of subjects in seeds, fruits, and grains .	24
Number of subjects in animal studies	37
Number of subjects in soil studies	62

Number of subjects in general farm management	33
Number of subjects given once	137
Number of subjects given twice	38
Number of subjects given three times	13
Number of subjects given four times	8
Number of subjects given five times	7
Number of subjects given six times	9
Number of subjects given seven times	5
Number of subjects given eight times	1
Number of subjects given nine times	2

"Principles of Selecting Seed," and "Testing Seeds for Food Materials," were each given eleven times; "Grafting," and "Milk Testing," thirteen times; "Seed Germination Tests," "Principles of Feeding," and "Soil Physics," fifteen times; "Grain Judging," sixteen times; and "Stock Judging," twenty-two times. Some replies, instead of giving subjects for laboratory exercises, simply referred to the exercises given in some text-book of agriculture. The number of these was twelve.

This summary shows that there is little agreement among schoolmen as to what principles of agriculture should be taught by means of exercises in the laboratory of the secondary school. It also shows that some selection of type experiments should be agreed upon.

2. The Notes of the Laboratory Exercises

Pupils should be required to write up in permanent form the notes of all the experiments and the verifications, and as many of the demonstrations and the practice exercises as the teacher may judge proper. There are several reasons for this: it affords an excellent training in expressing definitely and with exactness ideas that relate to science and physical phenomena; a much needed training is afforded in recording, interpreting, and using scientific data; by means of these written statements of the pupil the teacher *is better enabled to ascertain whether or not* the facts and principles have been learned; and the data, conclusions, answers, etc., are available for future reference. It is very desirable to have a certain form that is adaptable to all the four classes of exercises, and the pupil should be required to adhere to it. If this is done, the work of both teacher and pupil will be greatly facilitated,— the pupil in always having an outline to guide him and to suggest the necessary things to write about, and the teacher in having an orderly arranged and fixed plan to follow in his criticism. The pupil will also tend to acquire the habit of

preparing manuscripts according to some plan, and of being neat and careful with his written work. The following form has been worked out and used with success by the writer in connection with the high school classes in agriculture.

Exercise No. —. Date.

THE SUBJECT OF THE EXERCISE

I. **Performance.** — Under this head the pupil should present a full, exact, and plain statement of how the exercise was performed, giving the names of all pieces of apparatus used and explanations of how they were set up, the names of the different materials used and the quantity of each, the proper sequence of the various steps of procedure, and an exact description of each operation. These are the essential conditions of any exercise, and upon their relation depends its success. The pupil should recite these essentials with faithful regard to facts.

II. **Results.** — A statement of the results of the exercise should be given under this head. If possible, all data should appear in tabulated form, in order to be most available and to give the appearance of neatness. The results should be formal and exact, for they

are the bare facts of the exercise, — the bases from which principles may be drawn or laws established.

III. **Conclusions.** — The pupil should here state any principle or law which he has been able to induce from the results as interpreted in the light of the performance of the exercise. This is the vital aim of the exercise, and it should be concisely stated, free from all ambiguity. This portion of the exercise will serve to develop the pupil's reasoning power and strengthen his judgment. To prove that he clearly understands the relation between his data and his conclusions, the pupil should clearly and carefully state his reasons for making each conclusion. Otherwise, his assumption of knowledge may be challenged.

IV. **Answers.** — After laws and principles have been induced and stated comes the test of the pupil's intelligent understanding of them. This may readily be done by means of a few direct and well selected questions that go to the very heart of the exercise. The answers to the questions should be given under a separate head, and should be concise, plain, and definite. They should themselves suggest the questions they are intended to answer.

V. **Problems.** — Next, after the pupil has

gained knowledge, comes the development of ability to apply it. This may be accomplished by including a practical problem — not necessarily a mathematical one — in the exercise. This portion of the exercise offers an opportunity for originality, and provides for connecting theoretical knowledge with the practical affairs of life. If the problem happens to be mathematical in its nature, a neat solution of it should be presented.

VI. **References.** — It is often desirable to have the pupil read certain references on the subject of an exercise either before or after its performance, according to the nature of the exercise. If read before the exercise is undertaken, references often aid in the guidance of the pupil; this is frequently true in connection with practice exercises; if they are read after an exercise is finished, pupils are led to view the facts, principles, or laws from another's point of view; this tends to broaden the pupil's vision, and to strengthen his confidence in his own knowledge by finding it corroborated by the knowledge of others. The pupil should make a statement of the references that he has looked up and read on the subject of the exercise, and give an abstract of their contents.

MODEL NOTES OF AN EXERCISE

Exercise No. 6. *Sept. 15, 1910.*

TESTING GRAINS FOR STARCH[1]

I. **Performance.** — I filled a test tube about two-thirds full of water, placed into this a pinch of finely crushed corn, and then heated the contents of the tube to the boiling point by holding it over a flame. After allowing the liquid to boil a minute or two, I added, by means of a pipette, a few drops of diluted iodine solution, and then carefully watched for any reaction that might occur. I did likewise with finely crushed wheat, oats, rye, buckwheat, beans, peas, and rice. A blue *color appearing after the addition of* the iodine indicated the presence of starch, as was demonstrated in the preceding exercise.

II. **Results:** —

Grain	Starch	Grain	Starch
Corn	much	Buckwheat .	some
Wheat	much	Beans . . .	much
Oats	some	Peas . . .	much
Rye	much	Rice . . .	much

[1] The directions for performing this exercise will be found on page 174.

III. **Conclusions.** — The preceding table shows that the chief cereals are very rich in starch — carbohydrates. This class of foods, when eaten by animals, serves to give animal heat to the body, and is also used in building up adipose tissue (fat). Corn is raised in greater abundance than any other cereal in this country, and, being rich in carbohydrates, it should make an excellent feed for fattening hogs; this conclusion is borne out by actual practice. Oats, being less rich in this class of foods, does not furnish so great an amount of the heat-producing material, and hence makes excellent summer feed for horses.

IV. **Answers.** — It would be most profitable to manufacture starch from corn, rice, and wheat since these grains are very rich in this material, and all are raised in great abundance. The starch produced in the United States is chiefly derived from potatoes, corn, and wheat. Starch is used as a food, and in laundering, and in making paste.

VI. **References.** — I read concerning the manufacture of starch in the "Encyclopædia Britannica" and "The Student's Cyclopædia," under the heading, "Starch."

The following directions should be carefully

observed in the preparation of the manuscript of notes on the exercises. The permanent notes and drawings should be made in ink, since they represent the pupil's final knowledge on the subject and are to be kept for future reference. The drawings represent types; this will necessitate the observation of many specimens of the object, and the idea gained from a type drawing will be more correct than might result from the drawing of a single specimen. The directions for performing an exercise are usually given with the verbs in the imperative mode and the pronouns in the second person. Pupils are apt to imitate this; care should be taken to have them express the record of their own work with verbs in the indicative mode and the pronouns in the first person and either in the singular or plural number as the case may be. The three fundamental characteristics that the finished manuscript should conspicuously show are: neatness, exactness, and good English. Before submitting his manuscript to the instructor for criticism or approval, the pupil should carefully read it through in order to discover and correct any previously undiscovered errors.

Some difficulty will likely at first be experienced in the effort to get the pupils to

adhere to the form presented, and successfully to follow all the directions. To reduce this difficulty to the minimum, the first notes should be written under the immediate direction and supervision of the instructor, until some degree of proficiency is acquired. When the form becomes an habitual one, it will greatly facilitate the making of laboratory and field notes on the part of the pupil, and the instructor will find his work of examining them much reduced. From the very beginning, the instructor should insist that each item called for in the exercise be fully developed. In case any section needs to be omitted, the remaining sections should retain their usual number. For example, if the section headed "IV. Answers" were to be omitted, "Problems" should be numbered "V." as though section "IV." were not missing. This will facilitate the matter of referring to the various parts of the manuscript.

There may be some objection on the part of some teachers for using a set plan like this, the argument being that it tends to formalism in instruction, and that it tends to crush the individuality of the pupil, which already so greatly suffers from the press of uniformity in our modern school system.

But those teachers may rest assured that the pupil will develop some form in conformity to which he will write the permanent notes of the results of his exercises, and the chances are that it will not be so good as this form.

Pupils who have been under close supervision while working out an exercise and who have developed right habits of expression and of adherence to the proper form and to the instructions for developing the notes, may be permitted to write out their permanent notes at other hours than those usually spent in the laboratory. Carbon copies of the original data may be made in the laboratory and left with the instructor, and thus comparisons may be made with the permanent notes if the teacher desires to do so.

3. Directing the Laboratory and Field Work

In regard to the performance of the exercise, the pupil should follow with careful exactness and minute detail the directions which he receives for making manipulations, observations, and records. What may seem a very insignificant matter in the perform-

ance may greatly affect the final results of the exercise. The pupil should have some previous knowledge of what is expected of him in performing the exercise and to this end the printed directions should be carefully studied before entering the laboratory. With beginners, it is often advisable for the instructor to perform a part or even the whole of an exercise before the class and then allow the members of the class to perform it. Suppose seeds are to be tested for starch. The instructor may well first apply the test to cornstarch. This will show the pupils how to proceed and will also acquaint them with the reaction that will occur if starch is present. (See Exercise No. 5, p. 173.) By this means much time will be saved and many accidents avoided. It is also often advisable to give beginners oral directions. This will keep the entire class together, and those who lack initiative will be greatly helped. The exercise may often be introduced by a short talk by the teacher on the purpose of the exercise, the reasons for the method of procedure, the related facts which are or should be known, and the possible sources of error. After some facility in laboratory methods has been gained, the pupil should

be given the printed directions, and the oral introductions may be reduced in frequency. The class should have close supervision while at work in the laboratory.

In the performance of the exercises, it is always desirable to secure individual work. It is in this way that independence in original investigation is developed. When two or more pupils are working at the same exercise, it may be depended upon that not all are being equally benefited, nor is each securing the fullest experience or knowledge which it would be possible for him to receive were he working alone. The apparatus needed for the laboratory work of secondary agriculture is, for the most part, inexpensive, and every effort should be made to supply enough pieces so that individual work may be had. If this is not possible, not more than two pupils should be permitted to work together. There are some exercises wherein a combination of two members may result in good work.

The work of the laboratory and of the field or garden offers excellent opportunities for inculcating habits of order, system, and precision, which are qualities so desirable in every home, school, farm, and business house.

At the beginning of the exercise, the pupils should find their own apparatus, tools, and materials which they are to use. At the end of the laboratory or field period, the apparatus and tools should be cleaned and carefully placed in their assigned places, materials stored away in accordance with requirements, and all rubbish disposed of. The place where the exercise was performed should present as tidy an appearance after the work is finished as before it began.

"Since agriculture deals with gross and variable materials, the laboratory work in agriculture may easily be more technical and exact than the occasion warrants."[1] The teacher should remember that one purpose of the laboratory exercises is to teach facts to the pupil which the former already knows. The pupil is not a pioneer investigator along the frontiers of human knowledge, even when he performs an experiment; neither has he mastered the field of knowledge whereof some certain principle is a part, which he is now set to discover by means of an experiment. There is a vast difference between the original investigator and the average high

[1] Main, Josiah: "A Manual for High Schools," p. 9. University of Tennessee, Knoxville, 1909.

school pupil. The latter may, at times, be the former in the making, but at best it will only be in imitation and at infrequent intervals. The "scientific method" is not learned in a few years by immature adolescents; the scientific method is a highly developed product of very mature minds. Most high school pupils will do well if they learn the beginnings of that method; yet toward the end of the science course, even in secondary agriculture, a somewhat worthy beginning should be in evidence. Right instruction in agriculture in the high school will do much to develop a tendency and habit in scientific methods of thought and investigation among the masses. Elemental scientific principles of agriculture, and fundamental scientific methods of investigation may be combined. The two may thus go hand in hand, and neither will be sacrificed to the other. Indeed, if scientific method is seen by the pupil to solve vital and practical problems, as is ever possible in the proper teaching of secondary agriculture, the sanction which it will receive from the pupil will make its transference to other fields far more probable than if it is confined to the problems of pure science.

4. Time for Laboratory and Field Work

If the class in agriculture recites four or five times a week, and the recitation periods are forty to forty-five minutes in length, it is not advisable to have more than two double periods a week especially devoted to laboratory work. These periods should come on the first and last days of the school week so that growing crops, germination tests, etc., may receive proper attention without too great delay. But it should not be inferred that laboratory or field exercises should be limited to the days of the week that have the double periods. Such a mistake would prove most serious. The teacher should be free to conduct laboratory exercises on other days, and, if occasion warrants, to use the double period for a test, for a recitation, or for hearing reports from assigned readings or home experiments by various members of the class.

Many laboratory and field exercises are capable of being completed within an ordinary recitation period of forty minutes. On the other hand, there are numerous exercises in secondary agriculture that may be prepared within a few minutes, but that must continue for several days in succession before

they reach completion. Several such exercises may be started in a single period and stated observations made throughout the following days by all the members of the class. Pupils should be encouraged to make experiments and tests at home, and such work may be occasionally assigned to individual members, and reports called for in due time. (See illustration facing page 115.)

CHAPTER X

AN ILLUSTRATIVE LIST OF CLASSIFIED EXERCISES

The list of laboratory exercises on the following pages is not supposed to present a complete classified list of type exercises as a basis for a course in secondary agriculture. The purpose is to illustrate the relevant principles of this book, and to suggest how a course might be worked out in accordance with them.

It will readily be seen that the exercises are interchangeable; *i.e.*, an experiment or verification may be made a demonstration or *vice versa;* or a demonstration may be made an exercise for practice work or *vice versa.* The class into which any exercise may be placed will depend upon the purpose to which it is put. It might be desirable, for example, to give the pupils practice in the manipulation of apparatus, and training in systematic methods of procedure in laboratory work. Such an exercise as No. 6 on

page 174 may well be used as a practice exercise for securing the desired training instead of using it as an experiment. The classifications of exercises as given hereafter are merely suggestive.

I. Exercises in Plant Studies

Exercise No. 1. *A Demonstration.*

Seeds Contain Moisture

Place separately dry seeds from six different plants into as many test tubes, filling the tubes about one-third, and cork lightly. The preceding should be done before the class assembles. Show the seeds to the members of the class so that they may know them to be dry. Hold each tube in succession over a flame a few minutes, until moisture collects on the sides of the tube.

In the meantime explain the precipitation of moisture, and ask the following questions: Will a perfectly dry substance freeze? Will water when mixed with dust, flour, and the like, freeze? What makes mud freeze? Where does the moisture that collects on the sides of the tube come from? How do you know it does? Did the seeds seem perfectly dry at the beginning of this exercise? What

relation does moisture in grain have to the danger of its freezing? Should grain, which is intended for seed, be exposed to the cold? Why?

Form conclusions respecting the moisture contained in seeds and its relation to the storing of seeds. Express these conclusions in good English sentences and record them. Read what is said about the storing of seed corn and grain on page 17 of Farmers' Bulletin No. 229.

Exercise No. 2. *A Verification.*

The Peel of a Potato Prevents the Escape of its Moisture

Carefully weigh a potato; then pare another larger one, and cut portions from it until its weight is made equal to that of the first one. Set them away in some safe, warm place where they will be freely exposed to the air. After three to five days reweigh them.

Which potato weighs the more? Why? What does the result show in regard to the use of the skin? What relation does the fact learned from this exercise have to the digging, handling, and storing of potatoes? Write up this exercise according to the form and directions given you.

Exercise No. 3. *A Practicum.*

Judging Ears of Corn

Let each member of the class bring to the laboratory ten ears of corn that he considers first class for use as seed. Number all the ears thus brought in consecutively by sticking a long pin through a numbered tag into the butt end of each cob. This much should be done at least one day in advance.

As a preparation for the practice exercise proper, read two or more of the following references: (1) Farmers' Bulletin No. 229, pp. 8–11;[1] (2) "Ten Lessons on the Study of Indian Corn," pp. 9–16;[2] (3) The Agricultural College Extension Bulletin, September, 1906, pp. 4–7;[3] (4) "An Elementary Laboratory Study in Crops," Bulletin No. 26, 1907, pp. 22–27;[4] (5) Jackson and Daugherty's "Agriculture through the Labora-

[1] Address, Department of Agriculture, Washington, D.C. (Free.)

[2] Address, College of Agriculture, University of Missouri, Columbia, Missouri. (Free.)

[3] Address, Extension Department, College of Agriculture, Ohio State University, Columbus, Ohio. (Free.)

[4] Address, State Department of Public Instruction, Lansing, Michigan. (Free.)

tory and School Garden," pp. 246–249; (6) Nolan's "One Hundred Lessons in Agriculture," pp. 34–47.

Score card for Corn [1]

Points.		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Trueness to type .	10	—	—	—	—	—	—	—	—	—	—
2. Shape of ear . . .	10	—	—	—	9	—	—	—	—	—	—
3. Purity of color in grain and cob . .	5	—	—	—	—	—	—	—	—	—	—
4. Vitality, maturity, germinating power	20	—	—	—	—	—	—	—	—	—	—
5. Tips of ears . . .	5	—	—	—	—	—	—	—	—	—	—
6. Butts of ears . . .	5	—	—	—	—	—	—	—	—	—	—
7. Uniformity of kernels	5	—	—	—	—	—	—	—	—	—	—
8. Shape of kernels .	5	—	—	—	—	—	—	—	—	—	—
9. Length of ear . .	5	—	—	—	—	—	—	—	—	—	—
10. Circumference of ear	5	—	—	—	—	—	—	—	—	—	—
11. Furrows between rows	5	—	—	—	—	—	—	—	—	—	—
12. Space between kernels at cob . . .	10	—	—	—	—	—	—	—	—	—	—
13. Proportion of corn to cob	10	—	—	—	—	—	—	—	—	—	—
Total	100	—	—	—	—	—	—	—	—	—	—

Make a score card like the one shown above, providing one column for each ear of corn. The figures in the score card just to the right of the enumerated characteristics show the number of points that should be given for a perfect ear. If you think that ear number 4

[1] Adapted by permission from Bulletin No. 186, Office of Experiment Stations, U. S. Department of Agriculture. (See p. 59.)

is nearly perfect in shape, you will probably mark 9 in line 2, column 4, as shown in the table. Examine carefully each ear of corn and put down on the score card in the column of the same number as the ear of corn your estimate of the qualities named at the left of each line, except line 4 — Vitality — which should not be filled in until after the seed is tested in a later exercise.

When should seed corn be selected? Why? Compare the ear that received the highest total number of points from all the members of the class with the ear that received the lowest total number. Which kind of corn is the more economical and profitable kind to grow? Why?

Exercise No. 4. *A Practicum.*

Tongue Grafting

References: Farmers' Bulletin No. 157, pp. 18–19; Burkett's "Agriculture for Beginners," pp. 83–84; Bailey's "The Nursery Book," pp. 108–111. Study any two of these.

The graft is made by cutting the stock off diagonally, — one long, smooth cut with a sharp knife, — leaving about three-fourths of an

inch of cut surface, as shown in figure 1, *a*. Place the knife about one-third of the distance from the end of the cut surface, at right angles to the cut, and split the stock in the direction of its long axis. Cut the lower end of the cion in like manner, *b*; when the two parts are forced together, as shown at *c*, the cut surfaces should fit neatly together so that one will quite cover the other. It is essential that the cambium layers of stock and cion meet. Why? To secure this requirement, the stock and the cion should be nearly the same diameter at the point of contact so as to fit together nicely. After the cion and stock have been locked together as shown in *c*, they should be wrapped with five or six turns of waxed knitting cotton to hold the parts firmly

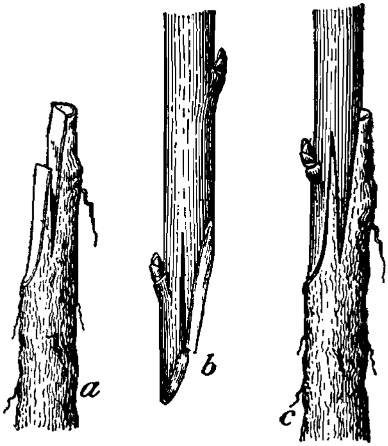


FIG. 1. TONGUE GRAFTING.
a, the stock; b, the cion; c, stock and cion united.[1]

[1] Adapted by permission from Farmers' Bulletin No. 157, U. S. Department of Agriculture. (See p. 18.)

together. Make several such grafts and hand each to the instructor as soon as it is completed. He will point out its defects for you, which you may remedy in your next attempt.

What is the purpose of grafting? Name the different parts of a graft. Why is this particular kind of graft called "tongue graft?" What other name is sometimes given to it?

The instructor should make at least one tongue graft before the class, being careful that all may clearly see him do it. He should explain all essential operations, and the reasons for them. When a pupil hands him a finished graft, it should be carefully examined, taken apart, the defects criticized, and the good points approved.

Exercise No. 5. *A Demonstration.*

How to Test for Starch

Stir a pinch of starch into a little water previously heated in a test tube. By means of a pipette, place a drop of iodine solution into the starch water, and stir it. There will appear a blue color in the tube. This is the test for starch, the intensity of the color varying with the amount of starch present. The pupils should attentively observe the

teacher while he is making this test. Pass the test tube to the various members of the class for closer examination.

Exercise No. 6. *An Experiment.*

Testing Grain for Starch

Bring about a gill of the following grains to the laboratory: corn, wheat, oats, rye, buckwheat, beans, peas, and rice. Grind or crush these seeds, and test the meal thus formed as your instructor treated the starch in the preceding exercise.

Tabulate your data in the following form:—

Grain	Starch	Grain	Starch
Corn		Buckwheat	
Wheat		Beans	
Oats		Peas	
Rye		Rice	

Write "much," "some," or "none," according to the reaction, in the proper spaces.

From which grains would it be most profitable to manufacture starch? Read on the process of manufacturing starch in an en-

cyclopedia. From what source is our starch mostly derived? What are some of the uses of starch?

It will be unnecessary to carry the illustration further than these few exercises presented in connection with plant studies. Complete lists of exercises similar to these, and in accordance with the principles established in former chapters, might be worked out under the five general heads of Chapter VII.: namely, (1) "Plant Studies," (2) "Animal Studies," (3) "Machine Studies and General Farm Management," (4) "Soil Studies," and (5) "Conditions of Plant Growth." It will be readily seen from the foregoing that a complete course in secondary agriculture may be organized, using laboratory and field exercises as the basis for the various topics to be studied. A course involving the principles of this book is designed to develop in the youth those modes of thought and action so essential to real success. There would be a tendency to develop active instead of sedentary habits, a love for the things of nature commonly met with on the farm rather than an inordinate attachment to books. The result should assist in producing in the pupil, not only those elements of character

and mental and physical ability to accomplish things so essential to a successful farmer, but also the fundamental characteristics that make for success when found in men of every walk of life.

2. An Exercise in Soil Studies

Only one more exercise, which comes under soil studies, will be given in order to satisfy the reference to it made on page 143.

Exercise No. 7. *An Experiment.*

The Effect of Mulch on Soil Moisture

Fill to within an inch of the top three one-gallon battery jars, or three one-gallon milk crocks, with equal amounts of loam by weight. (All the vessels must be uniform in size and shape.) Thoroughly moisten the soil in each vessel by pouring into each the same amount of water. Record the weights of the moistened soil. Set the jars away together, allowing the soil in one to remain undisturbed, firming the soil in another, and so soon as the soil in the remaining jar will permit, thoroughly cultivate its surface with a coarse-toothed comb to the depth of about an inch. Thoroughly cultivate the surface of the soil in the last jar

every day. Weigh the jars each succeeding day for a period of one week. Tabulate the various weights in a neat form.

Which soil loses its moisture most rapidly? least rapidly? How was the moisture lost? Did capillarity aid in bringing about this loss? How? Why was the soil in one jar left untouched? What conditions might cause an error in the results of this experiment? Were there any such conditions present in this experiment, and what were they? (If any serious condition of error was present, the experiment must be performed again, care being taken to eliminate the source of error referred to.) By what principle does a mulch of soil conserve the moisture? Should a crop be cultivated during a drought? Why? What is the effect of cultivating the soil as soon as it is in proper condition after a heavy rain? What would be the effect upon the soil moisture if the field is not cultivated after a heavy rain? What is one principle of cultivation as demonstrated by this exercise? Read what you can find on "mulch" in the agricultural books and bulletins in the library.

CHAPTER XI

EDUCATIONAL AIMS, VALUES, AND IDEALS

THE value of secondary agriculture as a really cultural subject, the methods of teaching it, and the ideals that it is supposed to implant have been subject to much adverse criticism. Agriculture, properly taught, may be made equally cultural with any of the science courses of the high school; the methods employed in the teaching of secondary agriculture are not radically different from those that should be applied to some of the other scientific and vocational secondary subjects; and the ideals which may be inculcated are surpassed by no other subject of the high school curriculum. These are criticisms that every new subject proposed for the high school has had to overcome; and unless a subject does fulfill high ideals, unless it may be efficiently taught, and unless it has a cultural value, it has no right to demand the serious consideration of high school men.

Like any other subject, agriculture has both immediate and remote aims. One of the immediate aims is that the pupils shall learn the fundamental principles that underlie the subject. Agriculture is a science, and as such it has a "body of knowledge (gained and varified by exact observation and correct thinking, methodically formulated and arranged in a rational system) in which the facts relating to the production of plants and animals useful to man and the uses of these plants and animals are accurately set forth, and a rational explanation is given of the phenomena and laws involved in such production and uses."[1] A course in high school agriculture should be one that involves the study of laws and principles, and not mere facts alone. Properly conceived, it will be sufficiently scientific and difficult to win the respect of both high school pupils and teachers. Textbooks intended for use in the secondary schools[2] should be as systematically arranged as regards their materials, the fundamental laws and principles of agriculture

[1] True, A. C.: "The Science of Agriculture," Annual Report of the Office of Experiment Stations, 1902, pp. 428–429.

[2] See the Appendix.

should be as earnestly and scientifically treated, and their explanations should be as logically and clearly expressed as is done in the best secondary textbooks of the principal sciences now taught in the high schools. The essential materials for the highest mental training are here found; an understanding of their right use alone is needed. Trained and efficient teachers will be needed to carry on this work, and these will soon be found.

Agriculture provides for definite motor education as well as for the education of the intellect. Agriculture is not only a science — it is also an art. The pupil must secure some skill in the application of the principles which he has learned. He thus learns to use his hands in accordance with the guidance of his mind. Physical education of no mean degree should result from the pursuance of a course of agriculture. Nor is agriculture devoid of an artistic setting. The farmer who, with the aid of Nature, produces the natural fruit, so juicy, mellow, odorous, and tempting; who produces flowers more delicate and beautiful than those which any painter ever placed upon the canvas, is an artist of no mean degree. Art, after all, is only a superior way of doing and making things, and the possibilities

for its achievement reside in the common as well as in the uncommon, at home as well as abroad, in the present as well as in the past or the future. Let us idealize our work and be artists.

By gaining knowledge of agriculture and experiences related to this great art of food production, the pupil gradually acquires a sympathetic attitude to it and to those who are engaged in its pursuits. He comes to appreciate its far-reaching possibilities, and its relation to mankind generally. In the contemplation of life, and in studying its forms and the conditions of their growth and development, the adolescent secures a true and clear conception of his relation to his and Nature's God. Life in all its forms comes to have a fuller and more serious meaning, and life in its special form of human existence comes to have a loftier and more sacred significance. But even this is not sufficient; one thing more is needed; the individual must go one step further before the requirements of a true education are fully realized. Not only must he possess these lofty ideals, but, in addition, the power, the disposition, and the habit of allowing them to direct him in active and efficient service; and this also agriculture seeks to accomplish.

Agriculture is practiced to produce economic results. It is one of the most practical of practical subjects. It deals with materials which are the commonest of the common to the great majority of our people, yet the principles and laws applied to the attainment of the ends most to be desired are not so well understood by them. Our people are also a commercially minded people. Life is commonly interpreted by them in terms of dollars and cents; not because they are incapable of conceiving life and true living as being something beyond this materialistic criterion, but because they have come to accept it as a common standard of measurement. A dollar represents a definite amount of life spent in service. If life and service are to be measured at all, the standard for such measurement must be a tangible and material one. This materialistic idea of the value of life and service is deeply rooted in the human species. It may be considered as being a phase of the property-getting instinct (acquisitiveness). Like many other instincts, it may function with an evil result, but the results of its functioning are not always evil; the very highest and best results often follow its functioning. Our problem is to secure

that sort of functioning of this instinct so that only good shall result. The functioning of this economic instinct must be translated into good habits, which are stable in their nature, and thus the salvation of the individual shall be reached through the modification of the very power that threatened his destruction.

The economic approach to the various subjects in secondary agriculture has, therefore, a double significance, — it is especially applicable to so practical a subject, and appeals to a dominating instinct of the race. But this economic conception of life is not the end to be attained; it is only a legitimate means to be used in order that the highest ideals of life may be successfully and more rapidly secured. The ideal can be assured of stability and efficiency in the life of the youth only when it is founded upon things that are real and that have something common with ordinary life; and its value will be proportional to the extent to which this is true.[1] "A culture, which, by its aloofness from the individual's practical life-interests, fails to

[1] Lloyd, Francis E., and Bigelow, Maurice, A.: "The Teaching of Biology in the Secondary School," p. 9. Longmans, New York, 1904.

irradiate and idealize these interests in some measure, is no culture. The individual is necessarily compelled to hold fast by the practical interests of life; and if the culture that any educational system has imposed on him is at variance with these interests, the culture goes to the wall."[1]

The attainment of economic results affords the opportunity of service, and in the endeavor to attain economic ends, society is best served by the honest individual, while the dishonest cannot be induced to render service in any other way. It has been said that the consummate end of German education is scholarship; that of English education is culture; but that of American education is service. Let us have true service, for the other two contribute to and are included in it.

[1] Davidson, John: "A New Interpretation of Herbart's Psychology and Educational Theory through the Philosophy of Leibnitz," p. 170. Blackwood and Sons, London, 1906.

APPENDIX

For the aid of school officials and teachers of agriculture in the upper grammar grades and the high school, we have attempted to make a rough classification of as many of the recent textbooks on general agriculture, intended for use in the upper grammar grades and the high school, as we have been privileged to examine. With the aid of the various publishers mentioned, the list below has been brought to a degree of approximate completeness.

FOR THE HIGH SCHOOL

Bailey, L. H.: "The Principles of Agriculture." The Macmillan Company, New York, 1907. pp. 300.

Brooks, William P.: "Agriculture." Three volumes. The Home Correspondence School, Springfield, Massachusetts, 1905. pp. 856.

Jackson, C. R., and Daugherty, L. S.: "Agriculture through the Laboratory and School Garden," Orange Judd Co., New York, 1908. pp. 450.

Warren, G. F.: "Elements of Agriculture." The Macmillan Company, New York, 1910. pp. 434.

WILKINSON, JOHN W.: "Practical Agriculture." American Book Company, New York, 1909. pp. 383.

LABORATORY MANUALS

BARTO, DANIEL OTIS: "Manual of Agriculture for Secondary Schools. Studies in Soil and Crop Production." D. C. Heath and Co., Boston, 1910. pp. 89.

DAVIS, CHARLES W.: "Rural School Agriculture." Orange Judd Co., New York, 1910. pp. 167.

LIGGETT, WILLIAM M., and HAYES, WILLET M.: "Rural School Agriculture, University of Minnesota, Bulletin No. 1." McGill-Warner Co., St. Paul, Minnesota. pp. 196.

McCALL, ARTHUR G.: "The Physical Properties of Soils." Orange Judd Co., New York, 1909. pp. 102.

STEVENSON, W. H., and SCHAUB, I. O.: "Soil Physics Laboratory Guide." Orange Judd Co., New York, 1910. pp. 80.

FOR THE UPPER GRAMMAR GRADES AND THE HIGH SCHOOL

BESSEY, CHARLES E.; BRUNNER, LAWRENCE; and SWEZEY, GOODWIN D.: "New Elementary Agriculture." University Publishing Co., Lincoln, Nebraska, 1909. pp. 198.

BURKETT, CHARLES WILLIAM; STEVENS, FRANK LINCOLN; and HILL, DANIEL HARVEY: "Agriculture for Beginners." Ginn and Co., Boston, 1904. pp. 339.

DUGGAR, JOHN FREDERICK: "Agriculture for Southern Schools." The Macmillan Company, New York, 1909. pp. 340.

EMERSON, GEORGE B., and FLINT, CHARLES L.: "Manual of Agriculture." Orange Judd Co., New York, 1905. pp. 284.

FERGUSON, A. M., and LEWIS, L. L.: "Elementary Principles of Agriculture." Ferguson Publishing Co., Sherman, Texas, 1909. pp. 318.

FISHER, MARTIN L., and COTTON, FASSETT A.: "Agriculture for Common Schools." Charles Scribner's Sons, New York, 1909. pp. 381.

GOFF, EMMET S., and MAYNE, D. D.: "First Principles of Agriculture." American Book Co., New York, 1904. pp. 262.

GOODRICH, CHARLES L.: "The First Book of Farming." Doubleday, Page and Co., New York, 1905. pp. 259.

HATCH, K. L., and HASELWOOD, J. A.: "Elementary Agriculture with Practical Arithmetic." Row, Peterson and Co., Chicago, 1907. pp. 198.

HILGARD, E. W., and OSTERHOUT, W. J. V.: "Agriculture for Schools on the Pacific Slope." The Macmillan Company, New York, 1909.

HUNNICUTT, JAMES B.: "Agriculture for the Common Schools." The Cultivator Publishing Co., Atlanta, 1906. pp. 277.

JAMES, CHARLES, and CRAIG, JOHN: "Practical Agriculture." D. Appleton and Co., New York, 1906. pp. 203.

LAWRENCE, WILLIAM T.: "Principles of Agriculture." W. and R. Chambers, London, 1904. pp. 115.

NOLAN, ARETAS W.: "One Hundred Lessons in Elementary Agriculture." Acme Publishing Co., Morgantown, West Virginia, 1909. pp. 285.

SHEPPERD, J. H., and McDOWELL, J. C.: "Elements of Agriculture." Webb Publishing Co., St. Paul, 1906. pp. 254.

SOULE, ANDREW M., and TURPIN, EDNA HENRY LEE: "Agriculture: Its Fundamental Principles." Johnson Publishing Co., Richmond, 1907. pp. 320.

UPHAM, A. A.: "An Introduction to Agriculture." D. Appleton & Co., New York, 1910. pp. 270.

WELBORN, W. C.: "Elements of Agriculture." (Southern and Western.) The Macmillan Company, New York, 1908. pp. 321.

WILSON, A. D. and E. W.: "Agriculture for Young Folks." Webb Publishing Co., St. Paul, 1910.

REFERENCE BOOKS

The Rural Science Series. The Macmillan Company, New York.

BAILEY, L. H.: "Garden-Making," 1898. pp. 424.

BAILEY, L. H.: "Nursery Book," 1896. pp. 376.

BAILEY, L. H.: "Principles of Agriculture," 1898. pp. 351.

BAILEY, L. H.: "Principles of Fruit Growing," 1897. pp. 533.

BAILEY, L. H.: "Principles of Vegetable Gardening," 1901. pp. 468.

BAILEY, L. H.: "Pruning Book," 1898. pp. 554.

CARD, F. W.: "Bush Fruits," 1898. pp. 549.

FAIRCHILD, G. T.: "Rural Wealth and Welfare," 1900. pp. 392.

JORDAN, W. J.: "Feeding of Animals," 1901. pp. 467.

KING, F. H.: "Irrigation and Drainage," 1899. pp. 523.

KING, F. H.: "The Soil," 1895. pp. 318.

LIPMAN, J. G.: "Bacteria in Relation to Country Life," 1908. pp. 506.

LODEMAN, E. G.: "Spraying of Plants," 1896. pp. 416.

MAYO, N. S.: "Diseases of Animals," 1903. pp. 475.

OGDEN, H. N.: "Rural Hygiene" (in preparation).

ROBERTS, I. P.: "Farmers' Business Handbook," 1903. pp. 313.

ROBERTS, I. P.: "The Farmstead," 1900. pp. 356.
ROBERTS, I. P.: "The Fertility of the Land," 1897. pp. 438.
ROBERTS, I. P.: "The Horse," 1905. pp. 412.
VOORHEES, E. H.: "Fertilizers," 1898. pp. 349.
VOORHEES, E. H.: "Forage Crops," 1907. pp. 397.
WATSON, G. C.: "Farm Poultry," 1901. pp. 351.
WING, H. H.: "Milk and its Products," 1897. pp. 324.
The Rural Textbooks. The Macmillan Company, New York.
DUGGAR, B. M.: "The Physiology of Plant Production" (in preparation).
DUGGAR, J. F.: "Southern Field Crops" (in preparation).
LYON, T. L., and FIPPIN, E. O.: "Principles of Soil Management," 1909. pp. 564.
Rural Books. Orange Judd Co., New York.

Descriptive matter of these series of books will be gladly sent by the companies publishing them upon application.

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